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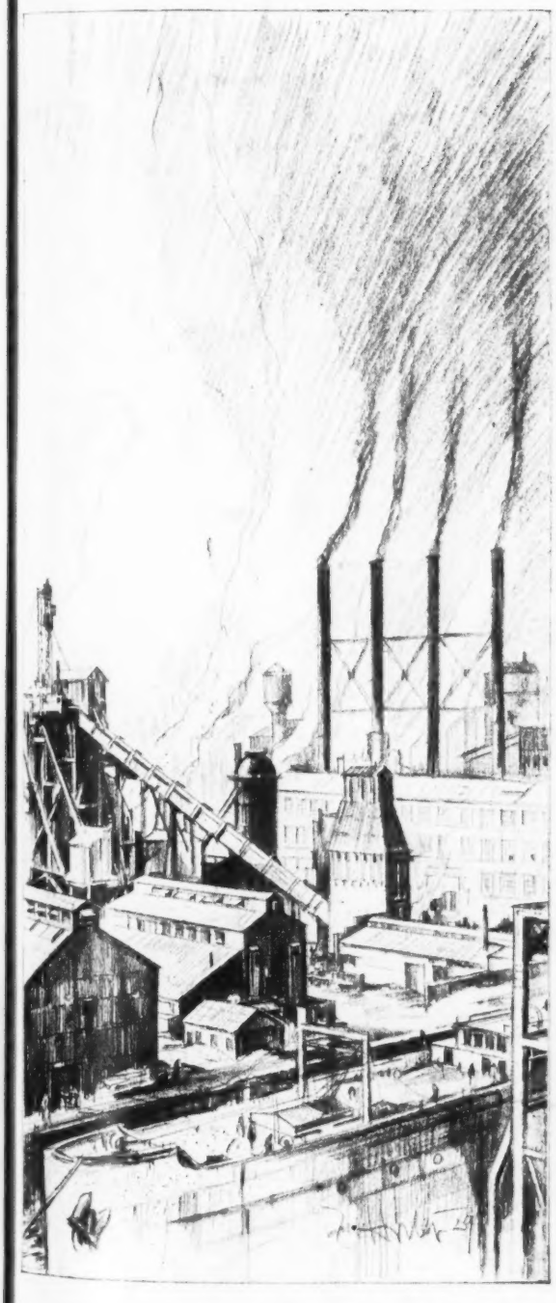

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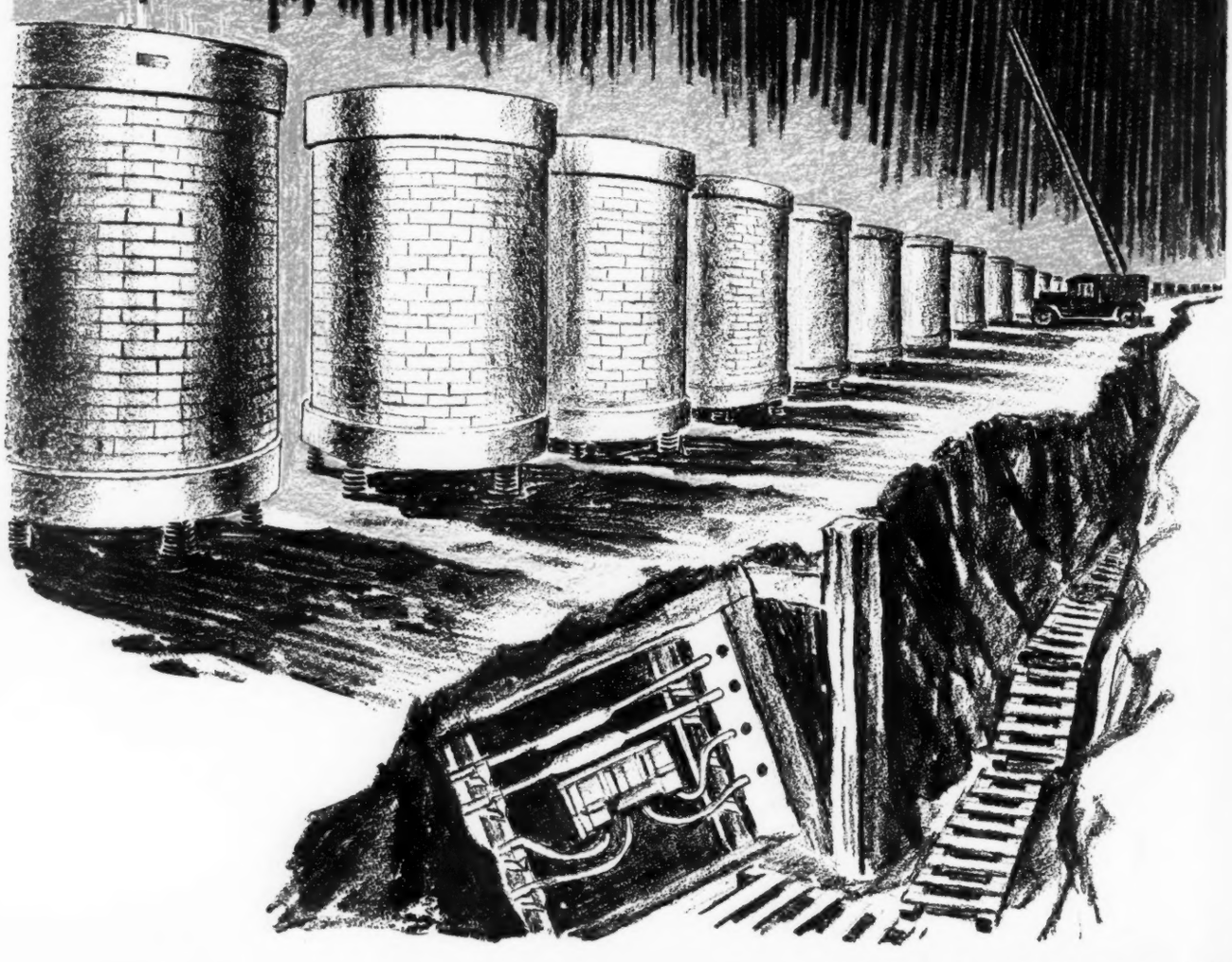

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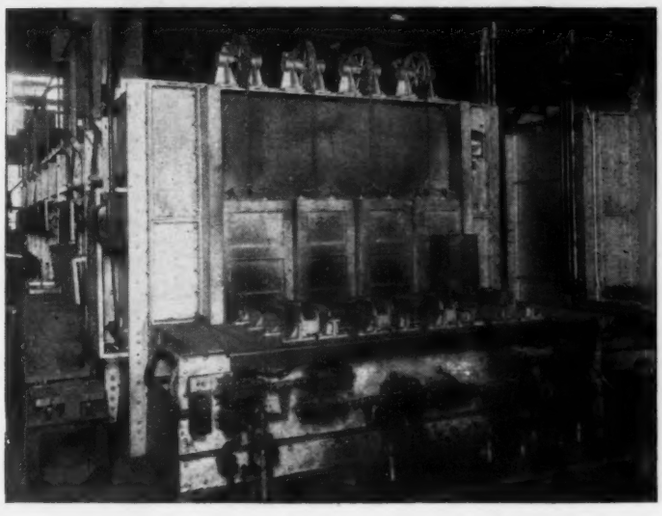

March 1, 1930

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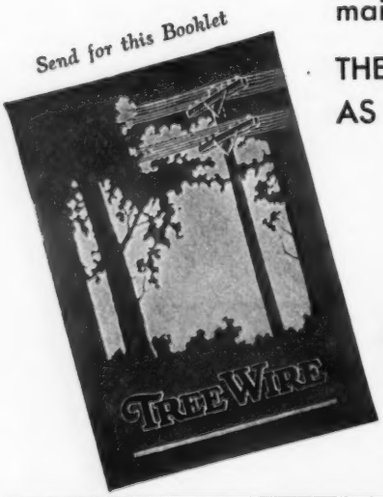

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ELECTRICAL WORLD

for the Week Ending

March 1, 1930

Comment On the News

ELECTRICAL STANDARDIZATION moved one step nearer simplicity and authority when the A.I.E.E. board promised support to a single standardizing agency functioning under the A.S.A. as sponsor of all electrical standards.

RAILROAD ENGINEERS are not worrying about where they can buy cheap and reliable power for electrified operation, if one does not misinterpret the current of thought underlying last week's A.I.E.E. meeting in New Haven. Contracts must be fair to both sides and take full account of abnormal traffic conditions, but with this approach the road becomes clear to a major offensive upon the economic and physical obstacles which bulk so large.

WHATEVER MAY BE THOUGHT of the plan to have a regularly appointed people's counsel represent the public in all rate proceedings before state regulating bodies, its actual adoption in Maryland has at any rate elicited eloquent testimony to the flexibility of the legal mind. For in a pending case the incumbent people's counsel, seeking to reduce the valuation of a petitioner, is opposed by two former people's counsels, doing their best for their new employer, the utility company in question!

WHAT WITH THE LOBBY committee of the United States Senate digging into ancient congressional history to find out about futile activities concerning Muscle Shoals legislation that never passed; what with the interstate commerce committee of the same exalted body constituting itself a court of review for internecine quarrels in the Federal Power Commission; what with the Federal Trade Commission ringing up the curtain on the second act of its utility inquiry, and what with the two factions of the legislative commission which investigated the regulatory laws of New York jostling for the limelight, it would be an understatement to say that the light and power utilities are occupying the center of the political stage—involuntarily they are "hogging" the whole of it. Obviously, so vast an industry cannot move in a tranquil orbit entirely its own. There will be political collisions and threatening comets. The price of harmony, like that of liberty, is eternal vigilance.

NEWS OF THE WEEK

Trade Board and Couzens Committee Both Hold Utility Hearings

LIGHT and power men who follow closely the proceedings at Washington that concern their industry had a double source of interest this week, when, not to mention hearings of minor importance to them, the Federal Trade Commission and Senator Couzens' interstate commerce committee conducted public investigations simultaneously.

•

Tyler, Bonner and Merrill appear before Senate committee

FOLLOWING the indorsement by President Hoover last week of a full-time Federal Power Commission, Senator Couzens suggested a new plan which is generally received as a good approach to the problem. He proposed the appointment of three new assistant secretaries under the Departments of Interior, War and Agriculture. Thus the power body would be under the direction of men unhampered by other duties. Their departmental connections would insure full co-operation of existing field agencies.

A clear statement against the setting up of an unwieldy accounting staff under any new form of commission was delivered by Lieut.-Col. M. C. Tyler, chief engineer of the Federal Power Commission, who was called on Tuesday, February 25, before the Senate committee on interstate commerce. Only 6.2 per cent of the nation's power in terms of capacity or 3.1 per cent in terms of value falls under the federal licensing system, he pointed out. The maximum proportion ever to be expected is 7.2 per cent of the capacity or 3.6 per cent of the value. After the available sites are taken the ratio will steadily decline. Colonel Tyler believes that the field forces of the three executive departments with a small central accounting staff can exercise, as in the past, proper control over this small element of the power business. He declared that O. C. Merrill, executive secretary of the commission until the appointment of F. E. Bonner a few months ago, failed to make use of the field offices and was primarily responsible for such delays in accounting as have occurred. It was Colonel Tyler's opinion that these offices are in a position to check 80 per cent of the facts relating to a project on the spot, which method he thinks preferable to an office compilation of documents and accounts.

When the water-power act was drafted, the witness continued, it was the plain intent of Congress to co-ordinate existing machinery by the addition of a small control body rather than to build up a large bureaucratic institution which would reach out for more and more power.

As requested by the committee, Mr. Bonner submitted a list of licensed projects and also a tabulation of 22 cases where cost items are in question. The companies having questionable claims in excess of a million dollars are: Clarion River Power Company, $5,259,736; Washington Irrigation & Development Company, $4,954,289; Alabama Power Company, $4,415,033; Susquehanna Power Company, $3,443,708; Niagara Falls Power Company, $1,500,000; Southern Connecticut Power Company, $1,050,000. In an attached report breakdowns of these items were given.

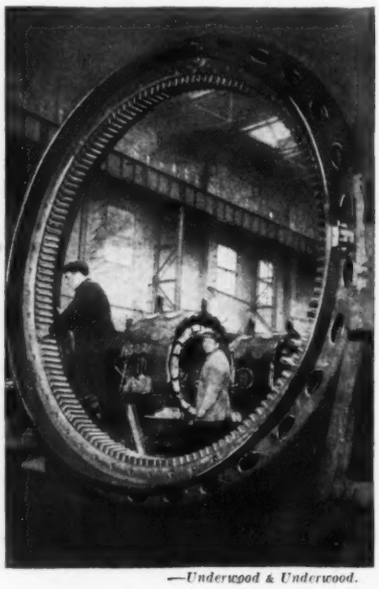
O. C. Merrill appeared on Wednesday to tell the Senators his version of the many-sided story. The delays in accounting, he claimed, were due wholly to the failure of the commission, the Bureau of Budget and Congress to accept his plea for added personnel.

Lacking the personnel, Mr. Merrill asserted, it would have been foolhardy to oppose the best legal talent of the utility companies in court cases. He stated, however, that he had taken all possible precautions to protect the public interests. For instance, it was the policy to keep a single power company, as far as possible, on one stream until all the good sites had been developed. This was to prevent the acquisition by one group of key sites on several streams which would shut out competitors.

Mr. Merrill charged that the members of the Federal Power Commission had, over his protest, eliminated from a report prepared by him for publication a reference to the accounting controversy with the Niagara Falls Power Company. This had been done when a representative of that company came to Washington after having learned about the reference. Mr. Merrill said that an editor with the McGraw-Hill Publishing Company not resident in Washington had seen an advance press copy of the report and had informed the company of its contents before the release date was effective.

Committee members sought to show by their questioning that Mr. Merrill, in his present capacity as executive secretary of the American committee of the World Power Conference, is serving a body subsidized by power-company money. The answer was that the utilities are the only and proper source to finance this organization, so useful in international relations.

After Wednesday's hearing, the argument was taken up on the Senate floor. Senators Norris, Nye, Dill and Wheeler bitterly attacked the commission's past policies. Senator Norris asked Bon-



—*Underwood & Underwood.*

LENINGRAD HAS PART IN RUSSIAN PLAN

Russia's program of electrical development is not confined to Moscow and the Ukraine. Here is a unit going in at the Leningrad "electrosila."

ner's immediate dismissal as a "power man" who has been trying to hide power-company steals under the guise of economy in personnel. He recommended that King and Russell be retained as faithful public servants.

On next Wednesday Secretary Wilbur is expected to testify.

•

Federal Trade Commission hearing not exciting

AT THE OUTSET the long-heralded Federal Trade Commission inquiry into the financial structure of utility groups looks like another long, tedious and relatively futile undertaking. Starting on Monday, February 24, the affairs of the American Gas & Electric Company came up for scrutiny with a room full of company officials in attendance. After three days spent in slowly poring over records and reports, little information which could not be found in Moody's Manual or other reliable compilations has thus far come to light, although the more extreme examples of rate bases have gone into screaming headlines in some newspapers. There will be weeks and months, perhaps years, of this without specific indication yet as to where it all is leading.

In an opening statement Robert E. Healy, chief counsel for the commission, cited the obvious limitation of the probe under the terms of the Senate resolution. The inquiry, he said, will be confined "to the growth of assets and liabilities as they appear on the books of account, together with obtainable information regarding the accuracy and propriety of such records." The question of fair value or fair rates will not be touched. These matters, Judge Healy pointed out, would involve many years of work and the expenditure of millions, a job similar in scope and nature to the railroad valuation. Regardless of the question of fairness, which is handled by local regulatory bodies, the rates of return on investments, rates for service, and that blanket assignment "other data," will be presented in the way of "statistical compilation and analysis for the information of the Senate."

The evidence thus far has reflected mainly to the credit of the American Gas & Electric. The principal testimony was offered by Judson C. Dickerman, an engineer with a long service record of public utility experience, who has been employed for the past several months as a special examiner for the commission, being assigned to a study of the A. G. & E. properties. Frank Buckingham of the commission's economic division also submitted a report delving into every phase of the company's corporate development. Other commission employees added to the testimony. Starting early in the century with virtually bankrupt properties, the group has grown from a capital value of $11,500,000 in 1907 to $127,500,000 in 1927. It now embraces ten subsidiary gas and electric units in nine states. In round numbers it serves 600,000 consumers in 1,300 communities.

Mr. Dickerman complimented the system on its efficiency of management and operation. Control of the subsidiaries is entirely in the hands of the main company by 100 per cent stock ownership. George N. Tidd, president of the parent firm, is president of all but one of the subordinate units and controls by a voting trust. Other officials hold several titles. The directorate interlocks with members of the Electric Bond & Share, United Gas Improvement, American Waterworks & Electric and Insull groups.

Perhaps the wealth of detail which accompanied the elicitation of the facts put before the commission may be considered as accumulated for initial background, some of which will be omitted in later hearings. Even so, the processes were thought by spectators to be needlessly slow. For example, one half hour was consumed in debating the validity of an item of $16,000 entered in 1906. Through this fully two dozen high-salaried company officials were obliged to sit. No subpœnas were issued, but the commission indicated that attendance of officers both of the main company and the subsidiaries was desired. On Wednesday, however, they were excused for a few days.

At Thursday's hearing a statement of management expenses of the American Gas & Electric Company was made as follows: Since 1917, for a period of thirteen years down to the end of 1927, the subsidiaries have received gross revenues of more than $460,000,000 and construction expenditures of $216,000,000, making a grand total exceeding $677,000,000. The gross management fee is 3.11 per cent of this amount, but actual expenses during the period reduced the management profit to 1.8 per cent.

According to John H. Bickley, commission examiner, the company received $12,571,970 from subsidiaries in 1928 in dividends, management and engineering fees. He stated that the engineering fees alone were sufficint to pay organization expenses exclusive of interest.

•

Gray, Coolidge, Norris and Muscle Shoals

MUSCLE SHOALS lobbying activities on a scale hitherto unsuspected were revealed by the Senate lobby committee this week as Chester H. Gray, Washington representative of the American Farm Bureau, was called to the stand. Active in support of the Cyanamid offer for the Shoals properties, Mr. Gray and his Alabama representative, A. O'Neal, according to the record, have used every possible means to impress their views on the people, on Congress and on the White House and are said to have had some influence in bringing about President Coolidge's pocket veto of the Norris bill. The picture will not be complete until William B. Bell, president of the American Cyanamid Company; Claudius Huston, Republican National Committee chairman, and Colnel J. W. Worthington of the Tennessee River Improvement Association have had a chance to present their side of the story.

Concerning a suspected agreement between the Cyanamid and the local power companies, Mr. Gray said he believed they had concurred in such a way that they could swear on the witness stand that no agreement had been made. He mentioned a conference with a delegation of power company officials headed by M. W. Aylesworth proposing separate bids on power and fertilizer, with which stand Mr. Gray did not agree.

Most of this evidence is political in bearing and will not materially affect the final disposition of the Shoals. The most likely action in Congress still seems to be the passage of the Norris public ownership plan, probably with the Black amendment providing private leasing with federal operation as an alternate.

SOUTH BEND TOWER NOW ALIGHT

When darkness falls at South Bend, Ind., the new Building and Loan Tower is illuminated by a battery of 35 500-watt Westinghouse projectors.

Two Reports on New York Commission Laws Made Public

SENATOR JOHN KNIGHT, as chairman of the commission created to investigate the Public Service Commission laws of New York, on Tuesday made public the report of the commission's counsel, Colonel William J. Donovan. It is upon the report of the

—Underwood & Underwood

William J. Donovan

counsel that the majority report and recommendations of the full commission will be based. Senator Knight made the counsel's report public in advance, he said, to permit any one interested to make suggestions to the investigating commission. There was no time for a public hearing, the report having to be submitted by March 1.

Asserting that in taking this action Senator Knight sought an unfair advantage, Frank P. Walsh, one of the three appointees of Governor Roosevelt to the commission, at once gave out the minority report prepared by himself and Prof. James C. Bonbright of Columbia University, the third gubernatorial appointee, David C. Adie of Buffalo, being incapacitated by illness from participating.

Mr. Donovan's presentation

Mr. Donovan's report, comprising 217 pages, undertakes an analysis of the 5,816 pages of testimony taken at the 43 hearings of the commission, at which 95 witnesses testified, and of the material prepared by the research staff. In his letter of transmittal he states that he does not undertake to make definite recommendations as that is the function of the investigating commission. However, in Part I of the report he makes a full presentation of the problems now confronting the Public Service Commission.

Mr. Donovan also discusses the criticism directed at the present Public Service Commission, dealing particularly with the charge that it has become a judicial body rather than one primarily aiming to serve the public interests. He gives consideration to the procedure followed in handling rate cases, consolidations, mergers, accounting and auditing.

If, says Colonel Donovan, the public utilities are seeking to destroy legislation and will submit only to the forces of coercion and compulsion, then the Public Service Commission must be regarded as a kind of police agency. On the contrary, if the interests of the state and the utilities are not in conflict, but are consistent one with the other, the utilities being under a charter of trusteeship, then regulation should be based upon a standard of social conduct with reciprocal obligation. There are, he holds, but the two alternatives—regulation based upon a spirit of co-operative effort, or public ownership with whatever evils might prove to be attendant.

Concerning rates a proposal is discussed involving the fixing of the valuation of every utility at the present time by contracts extending for not more than ten to fifteen years, with an agreement between the state and the utility on rate of return and on the addition only of actual investment to the valuation.

In dealing with the impairment of the work of the commission by federal court intervention, Mr. Donovan discussed the suggestion for legislation providing that whenever a suit for an interlocutory injunction shall be begun by a utility in a federal district court, to restrain an order of the commission, the commission shall be authorized to bring a suit to enforce its order in the Appellate Division of the State Supreme Court at any time before the hearing on the application for an interlocutory injunction and that the statute shall provide for a stay of the enforcement of the commission order until the determination of the case in the Appellate Division.

In the matter of holding companies the counsel develops the suggestion that any abuses arising from management contracts shall be met by requiring that such contracts shall be submitted to and approved by the Public Service Commission, that the commission shall have access to the accounts and records of every company having transactions with an operating company, and that the commission shall have complete regulatory control over every holding company actually operating a public utility corporation, and finally that it shall have power to require the complete disclosure of the identity of every person having any substantial interest in the voting stock of the public utility corporation.

Discussion is also included on the proposal that the Public Service Commission, which now is a body vested with the duty of investigator, prosecutor and

—Underwood & Underwood

Frank P. Walsh

judge, shall have these functions divided; that there shall be an administrative division charged with the duty of inspecting the service, of investigating complaints and of presenting cases, and that there shall be another body solely judicial in character in the nature of a court of commerce.

In addition, there is presented the suggestion of a people's counsel, with an enumeration of the duties he should perform. He would be placed either in the Attorney-General's office or in the proposed administrative division of the commission and be charged not only with the handling of complaints from the public but with assisting municipalities in the presentation of their cases.

Walsh and Bonbright go far

Ten concrete recommendations are made in the report of the Governor's appointees, who declare that regulation has broken down and assail the public utility companies as chiefly responsible. The ten recommendations are, briefly:

1. Establish the prudent investment principle as the public policy of the state for purposes of rate control. The plan suggested by Commissioner Bonbright for the application of the prudent investment standard to existing property and for its effec-

tive administration in the future has our hearty indorsement.

2. Establish a new uniform system of accounts worked out by a committee of experts with a view to revealing completely the costs, both capital and operating, of the various classes of service.

3. Provide for a people's counsel, appointed by the Governor of the state, with authority to initiate and handle cases in the interest of the public before the Public Service Commission and if necessary in the courts.

4. Provide for a regular monthly publication by the Public Service Commission, aiming to distribute in popular form knowledge of the utility situation as reflected in the data assembled and the cases before the commission.

5. Provide for control by the Public Service Commission over all construction or additions to plant and equipment, however financed, in order to close this loophole for excessive costs and overcapitalization. All expansion programs should be approved by the Public Service Commission in advance. The commission should also have control over the contractual relations between companies subject to holding-company control and the associated engineering, financial, legal and accounting companies and should have the power to disapprove of any such contract in which all the books showing the costs involved are not open to its inspection.

6. Authorize municipalities to undertake public competition, if their citizens so desire, granting municipalities the power to build their own plants and distribution systems, without the necessity of securing a certificate of convenience and necessity from the Public Service Commission, and power to acquire private systems by agreement or condemnation, provided the cost does not exceed the cost of building a municipal system.

7. Authorize municipalities to serve the surrounding territory without continual appeal to the Legislature for that privilege.

8. Authorize municipal plants to replace private plants at the end of the franchise period of the latter without obligation on the part of the municipalities to purchase the often antiquated private plants.

9. Authorize municipalities to form power districts for the purpose of supplying electricity at cost to municipalities within the district.

10. Provide larger salaries for the chairman, members and staff of the Public Service Commission.

The minority report also includes three charges against the existing New York Public Service Commission. These concern (1) alleged failure to check the validity of company expenditures charged to operating expense; (2) alleged failure to protect the public in the matter of the coal surcharge on rates, and (3) handling of the Long Island Lighting Company case to the alleged detriment of the consumers.

It is alleged as bearing out the first of these charges that an item of $1,302,782 was paid by the New York Edison Company over a period of twelve years to Benjamin F. Witbeck, who had previously been an employee of the State Tax Department, for obtaining for the company "what appear to have been fictitious reductions in the yearly assessed valuation of Consolidated Gas Company properties in New York City for special franchise tax levies." These payments were not made under the present New York Edison administration.

Concerning the Witbeck matter Senator Knight, chairman of the investigating commission, said that it was not new and that the validity of the payments was still undecided by the Public Service Commission, before which rate proceedings affecting the New York Edison Company have been pending for several years.

Railroad Electrification Experts at New Haven

ENGINEERS in charge of electrification on the Pennsylvania, Reading, Lackawanna and New York Central systems addressed a crowded meeting of the Connecticut Section of the A.I.E.E. in New Haven on February 19, outlining the equipment being provided for these important projects and discussing various aspects of the problem of changing trunk-line transportation lines from steam to electric motive power. Sidney Withington, electrical engineer New Haven lines, presided.

In the order in which the railroads have been named J. V. B. Duer, George Wright, E. L. Moreland (of Jackson & Moreland) and H. A. Currie pictured the trend toward the use of labor-saving machinery in field construction, touched upon the general acceptance of purchased power for heavy railroad operation, showed views of transmission and distribution apparatus for this service and emphasized the importance of thorough planning of construction progress in order to complete such jobs within the required time limits.

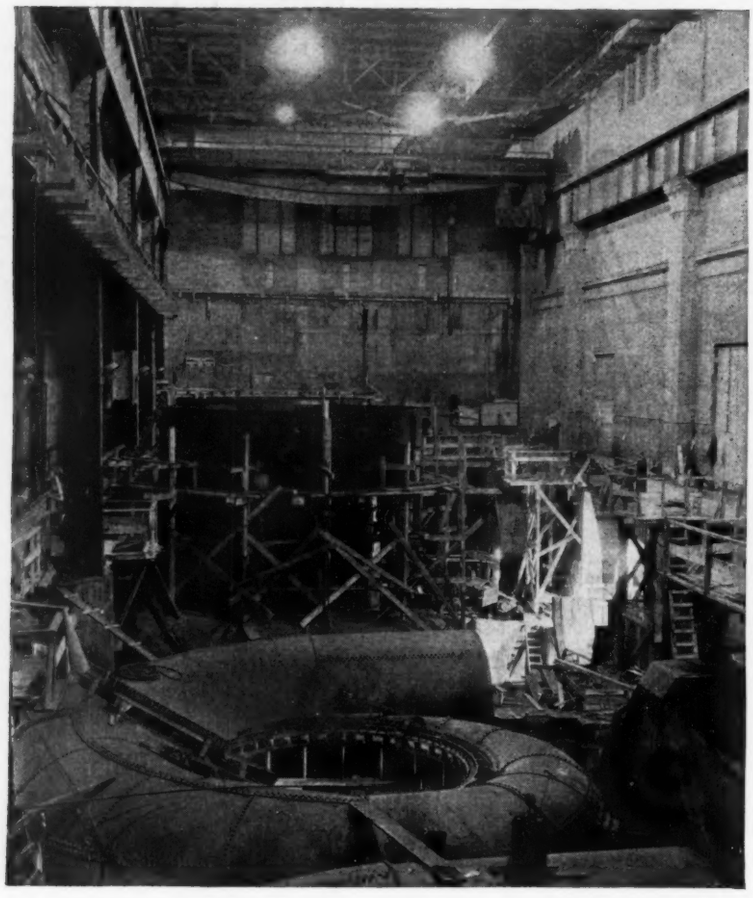
It was brought out that mercury-arc rectifiers are pushing rotating machinery hard in conversion work and that this apparatus is now able in certain cases to withstand overloads of one and one-half times rating for two hours, three times rating for five minutes and six times rating for ten seconds.

The so-called "service-at-cost" type of power contract is receiving considerable recognition in view of its flexibility and the varying demand.

NEW ORLEANS INAUGURATES "WHITE WAY" ON CANAL STREET

New Orleans' long-talked-of "white way," covering a mile on Canal Street from the river to Claiborne Street, was inaugurated amid great enthusiasm this week in time for the Mardi Gras festival, Thomas A. Edison touching the button. Each of the 109 31-ft. pressed-steel standards, spaced 100 ft. apart on the 170-ft.-wide thoroughfare, carries three 1,000-watt lamps; 2,000-watt lamps can be used. The work was done by the New Orleans Public Service, Inc. Including street beautification, it cost $3,500,000.

FIFTEEN-MILE FALLS FORGES AHEAD



Rapid progress is being made in the erection of hydro-electric units at the Fifteen-Mile Falls lower development of the New England Power Association on the upper Connecticut River near Littleton, N. H. Four 50,000-hp. turbines are going into service next fall

Are State Anti-Trust Laws Applicable to Utilities?

SUIT brought against the Union Electric Light & Power Company of St. Louis by the Wiles-Chipman Lumber Company under the Missouri anti-trust law has been transferred to the Missouri Supreme Court *en banc* for decision as to whether or not the law creating the Public Service Commission of that state superseded provisions of the pre-existent anti-trust law. An interest more than state-wide attaches to the case, in which one division of the court has already held that the anti-trust clauses have been so superseded.

Triple damages were asked by the Wiles-Chipman company on allegations that the Union Electric Light & Power Company and the Laclede Gas Light Company had entered into a combination by which the latter refused to supply the lumber firm with power for its planing mill. The Laclede company was not made a party to the action, but the North American Company, which controls the Union company, was. The decision that now goes for review to the whole bench reversed the judgment of the Circuit Court as to both the Union Electric and the North American company.

▼

Maryland Commission Investigates Merger

VALUATION of all the physical properties of the fourteen Maryland public utilities included in a proposed amalgamation by the Empire Public Service Corporation, through its holding company, the Maryland Light & Power Company, is now being rushed to completion by the entire engineering staff of the Maryland Public Service Commission in an effort to present the data collected to the commission on March 3.

Values as estimated by this examination will be used by People's Counsel John H. Lewin in an attempt to disprove the valuations submitted by the corporation for the purpose of issuing $1,200,000 in stock to finance the transaction.

The fourteen companies involved in the proposed merger serve electricity to counties in all sections of the state except in the northern central part. Clarence W. Miles and Thomas J. Tingley, both former people's counsels, are representing the power interests in the case.

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A.I.E.E. Asks Sole Electric Standardizing Body

UNIFICATION of standardization activities in the electrical field, nationally and internationally, is the broad purpose of action just taken by the board of directors of the American Institute of Electrical Engineers. For a long time the Institute was the only recognized standardizing body in that field, but more recently commercial associations and governmental bureaus have developed an increasing interest in standards. With many bodies functioning more or less independently there has been unnecessary duplication of effort, unnecessary expenditure of time and money and, in some instances, conflicting "standards."

The organization twelve years ago of the American Engineering Standards Committee was a forward step for which the A.I.E.E. was largely responsible. Its successor, the American Standards Association, has, because of constitutional limitations, been able to do little to eliminate duplication and jurisdictional difficulties among its member associations. In order to accelerate the clarification of the situation, the A.I.E.E. board of directors on January 29 passed the following resolutions:

The American Institute of Electrical Engineers, recognizing that other organizations in the electrical industry have the same fundamental interest in electrical standardization as the A.I.E.E., namely, aiding in and guiding the proper development of the electrical industry in the United States, hereby resolves:

That the American Institute of Electrical Engineers approves in principle the formation of a joint agency of the electrical industry for the purpose of carrying out the necessary standardization activities of that industry; that the president of the A.I.E.E. is hereby authorized to take appropriate steps to propose this action to the interested electrical associations, preferably through the electrical advisory committee of the American Standards Association; that the Institute declares it to be its intention that, on the consummation of an organization satisfactory to the Institute for this purpose, the Institute, in general, will refer to that body the consideration and approval of standards in which it is interested.

In the resolution it is explained that the contemplated agency shall have

three distinct components, (a) the electrical standards committee of the electrical industry in the United States of America, (b) the electrical advisory committee of the American Standards Association, (c) the United States national committee of the International Electrotechnical Commission and of any other international organizations for the handling of electrical matters.

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Central Illinois P. S. Rates Are Reduced

A NEW rate schedule has been filed with the Illinois Commerce Commission by the Central Illinois Public Service Company reducing its rate of service by one cent in 440 Illinois cities and surrounding rural districts, effective April 1.

For urban and rural residence lighting service in all of the towns except Quincy the rate for the first step is reduced from 11 cents to 10 cents per kilowatt-hour for 3 kw.-hr. per room for three rooms plus 2 kw.-hr. per room for each additional room, the basis being changed to six rooms. For commercial lighting, the rate drops from 11 cents to 10 cents per kilowatt-hour for the first 30 hours' use of the customer's maximum demand per month. For the city of Quincy the drop is in the third step. It gives a rate of 3 cents instead of 4 cents after the first 8 kw.-hr.

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Boulder Dam Applicants in California Agree

AGREEMENT between California factions as to the division of waters from the Boulder Canyon project has been reached after a series of meetings held last week in Los Angeles. Of the 4,400,000 acre-feet allotted to California from the "Class A" main stream waters, the agricultural group—that is, the Imperial Valley—is to get 3,850,000 and the Metropolitan Water District 550,000. From the unapportioned surplus the Metropolitan district will receive an additional quantity up to 550,000. Any remaining surplus available to California over this 1,100,000 acre-feet will go to the Imperial Valley. Apparently Arizona's stake in the surplus might reduce the Metropolitan allotment to 1,050,000 acre-feet after the ultimate developments for use have been made, but this is an eventuality of no present consequence.

This agreement seems to clear up the situation as concerns division of water. No further action is yet reported on power allocation.

Power Commission to Pass Upon Safe Harbor Project

THAT the Safe Harbor power project on the Susquehanna River falls under the federal licensing system was held at an executive meeting of the Federal Power Commission on Wednesday of this week. This thirty-million-dollar development by a subsidiary of the Pennsylvania Water & Power Company will, it is believed, furnish power to the Pennsylvania Railroad for electrification as well as to other consumers.

License was granted for a 5,200-hp. project of the Telluride Power Company of Salt Lake City, which has been partly constructed on the Beaver River and tributaries within Fishlake National Forest, Utah. Some other minor developments, mostly under 1,000 hp., also were approved for permit or license.

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Cleveland Company Again Reduces Rates

VOLUNTARY reductions of electric rates which will bring an estimated saving of $800,000 annually to customers were announced on Wednesday by the Cleveland Electric Illuminating Company. The rate change applies to residential and small commercial customers. The new schedules will become effective after commission approval. This is the sixth voluntary reduction of rates made by the company within ten years, the announcement says, and applies to Cleveland and 129 other communities served by the utility.

▼

Competition in Rural Territory Allowed in Oregon

DIVERGENCE of opinion arose recently in the Oregon Public Service Commission when that body entered an order which granted an application of the Edward Hines Western Pine Company for permission to furnish electric light, heat and power in territory adjacent to the town of Burns, thereby restricting proposed operation of the People's West Coast Hydro-Electric Company. The commission in its order recognized the People's West Coast company as being the rightful and exclusive occupants of the city proper, but nevertheless held that the Hines lumber company was entitled to claim for its operating field certain territory immediately adjacent to the municipal boundaries.

Commissioner H. H. Corey in a dissenting decision said:

In this case there is in effect a choice of permitting a recognized and existing public utility which has recently increased its power production capacity at large expense to serve a sparsely settled area, or permitting a corporation whose business is primarily that of manufacturing lumber to serve a part of said territory, or pos-

"WORLD'S LARGEST" ROCK-FILLED DAM

Three million cubic yards of granite rock will be used in the Salt Springs Dam, which is a part of the Mokelumne development of the Pacific Gas & Electric Company, to cost $36,000,000. The dam will be 330 ft. high, 900 ft. thick and 1,300 ft. long. Caterpillar Tractor Company apparatus is here shown.

sibly, as the record shows, the service may be rendered through a real estate firm. . . . Neither the people of the towns nor the people residing on the nearby ranches can legally place a burden upon the other in the matter of public utility service and rates. The extent to which the maximum good of each must yield to that of the whole, and what difference in rates should bar the granting of the best service to the greatest number, are questions of fact for this commission to consider and determine. It is the prevailing tendency of the time, supported by public policy, to equalize or apportion so far as reasonable the advantages as between rural and suburban sections and to promote the growth and prosperity of the whole community involved. The commission in deciding this case should look to the future and attempt to ascertain what will be the consequences if two public utilities are allowed to compete in the same territory.

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Indiana Utility Plans Ahead at Michigan City

LAND comprising approximately 200 acres at Baileytown, between Gary and Michigan City, Ind., has been acquired by the Indiana Industrial Land Company, a subsidiary of the Midland United Company, for future development as a site for an electric generating station. No development, however, will be made for several years.

The Northern Indiana Public Service Company, also a subsidiary of the Midland United Company, is building a new generating station at Michigan City with an initial capacity of 64,000 kw. and an auxiliary unit of 4,000 kw., and the new purchase is for the purpose of obtaining another station site.

President Renominates Present Radio Board

ALL the members of the existing Federal Radio Commission have been renominated by President Hoover, the chairman, Ira E. Robinson, being named for a two-year term; Eugene O. Sykes for three years, William D. L. Starbuck for four years, Harold A. Lafount for five years and Major Gen. Charles McK. Saltzman for six years. Judge Sykes, vice-chairman, is the only member of the original commission.

Nomination by the President of Charles A. Stone, of Stone & Webster, to fill the vacancy caused by the retirement of Charles E. Hughes as a member of the board of regents of the Smithsonian Institution had at the time of writing not yet been definitely approved by the Senate. A first vote of confirmation was rescinded on the motion of Senator La Follette, who wanted his fellow Senators to consider "whether we are to continue the policy of filling the key positions with representatives of the power trust."

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Kentucky Legislators Are Against Cumberland Plant

BY A VOTE of 63 to 30 the Kentucky House of Representatives voted last week in favor of a bill to accept through the State Park Commission an offer of approximately $230,000 from former Senator T. Coleman du Pont for the purchase of property adjacent to Cumberland Falls, and it also passed a companion bill, by 92 to 1, giving the state the power of eminent domain to condemn property for park purposes. The property that Mr. du Pont offers to buy is that owned by the Insull interests, which have long been waiting a permit from the Federal Power Commission to develop power at the falls.

Survey of the actions and service of public utilities in Kentucky is called for in a resolution introduced in the House of Representatives at Frankfort. The committee, which would be a joint one composed of three senators and three representatives as well as the Lieutenant Governor and the Speaker, would not be required to report back to the Legislature until the 1932 session.

A Senate committee was named two years ago for the same purpose and held some meetings.

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Carlisle Criticises Russell Testimony

WRITING to Senator Couzens, before whose committee he is to give testimony when it reaches the question of power distribution, Floyd L. Carlisle, chairman of the board of the Niagara-Hudson Power Corporation, said under date of February 26, referring to the testimony of Solicitor Russell of the Federal Power Commission:

"The unfortunate inference from Mr. Russell's statement was that the company had been charging rates to consumers in New York State based upon a very large appraisal of water-power rights. This is absolutely contrary to the facts. . . . The Niagara Falls Power Company has never entered upon its books any values for its water rights and privileges and, of course, has never based rates thereon."

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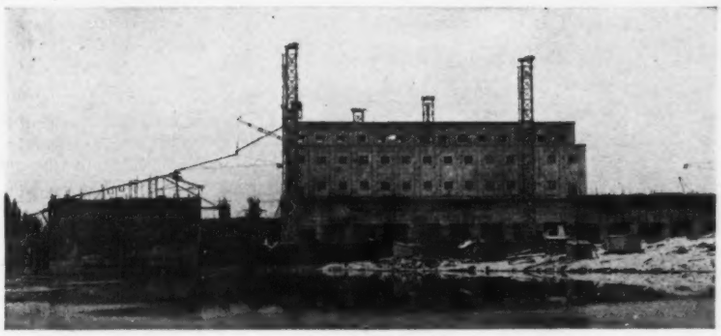
Red Wing Drops Project on Mississippi River

DECISION to drop its plan to obtain power from the new federal dam across the Mississippi River at Hastings, Minn., has been taken by the Red Wing (Minn.) City Council after receipt of a letter from the Federal Power Commission rejecting the city's application for a preliminary permit. Rejection was made on the ground that the power project is impracticable because of high cost and engineering factors. Several nearby cities, of which Rochester was the most active, joined Red Wing in the original plea for a permit.

LIGHTING A SKATING POND FROM BELOW

Outdoor pleasure seekers at the Lake Placid Club in the Adirondacks, N. Y., now skate over ice illuminated by colored incandescent bulbs, frozen in it and forming an 18-ft. star. L. G. Porter, General Electric engineer, made the novel installation.

SASKATCHEWAN'S FIRST HYDRO PLANT



The first hydro-electric plant to be erected in the Province of Saskatchewan is approaching completion at Island Falls on the Churchill River and is designed to include six units of 14,000 hp. each, three of which will be at once installed. The plant, which is owned by the Churchill River Power Company, a subsidiary of the Hudson Bay Mining & Smelting Company, is to start operation next fall.

Seattle May Burn Pulverized Coal Instead of Oil

IF A PLAN proposed by leaders in the coal-mining industry in Seattle and the surrounding district is accepted by the City Council, the boilers in the Seattle municipal steam plant on Lake Union may be rebuilt to burn pulverized coal, eliminating the use of oil at the plant. Coal men declare that increased efficiency could be thus effected and the cost of power production greatly curtailed. The councilmen have asked that concrete plans be submitted.

Councilman Tindall said the plan would work to good effect if a bond issue to come before the voters at the March election is carried. It appropriates $400,000 for additions or extensions to the steam plant.

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Recent Expansions in Canada East and West

IN RECORDING expansion and growth in 1929, the Canadian Hydro-Electric Corporation reports that generators with an aggregate capacity of 83,000 hp. were installed in the Farmers, Chelsea and Bryson hydro-electric plants of the Gatineau Power Company. In the Farmers power house on the Gatineau River an additional 24,000-hp. unit raised its total installed capacity to 96,000 hp., and the 34,000-hp. generator started in the Chelsea station, a mile above Farmers, increased its installed capacity to 136,000 hp. With the addition of these generators, the Gatineau Power Company now has 439,000 hp. installed and in operation in its four plants on the Gatineau River.

Under its three contracts with the Ontario Hydro-Electric Power Commission, the Gatineau Power is now delivering 182,000 hp., of which 150,000 hp. is being transmitted by a 220-kv. transmission line 230 miles long. The present deliveries of 182,000 hp. to the commission reflect an increase of 76,000 hp. over the amount being delivered a year ago.

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THE PROGRESS of the Province of Saskatchewan in government ownership of power plants and electrical distribution systems is set out in the first annual report of the Saskatchewan Power Commission. The Commission, brought into existence by the Power Commission act, assented to on January 18, 1929, had up to the end of the year invested $2,877,492. The heaviest investment was in the Saskatoon plant, represented by the sum of $2,597,848. Ten small-town plants have also been acquired, and negotiations are in progress with the cities of North Battleford and Swift Current for the purchase of their plants.

Another section of the report deals with the investment of private interests in power generation and distribution in Saskatchewan. It is stated that there is no official record of investment by three large power companies now operating in the province, but an estimate places the total at $5,400,000, including plants and transmission lines and the purchase of franchises. These figures do not include the purchase price of the Moose Jaw plant, which was taken over recently by the Iowa Southern Utilities Company for $2,875,000. Urban population of the province served by organized power plants at the end of 1929 was estimated at 210,000, of which number 153,000 people were served by plants under public ownership.

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CONTRACTS totalling more than $350,000, covering costs of erecting a provincial power line extension between Portage la Prairie and Brandon, have been awarded by the Manitoba government. The line, which will be 82½ miles in length, is expected to be completed before the end of the summer. The entry of the provincial hydro system into Brandon will pave the way for further extensions into Neepawa, Minnedosa, Gladstone and other points in northwestern Manitoba. Every unit under construction in Manitoba will be needed at once.

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Coming Meetings

Oklahoma Utilities Association — New Tulsa Hotel, Tulsa, March 11-13. E. F. McKay, 1020 Petroleum Bldg., Oklahoma City.

Northwest Electric Light and Power Association — Accounting Section, Portland, March 17-18; Engineering Section, Aberdeen, Wash., March 26-28. B. Snow, 1206 Spalding Bldg., Portland, Ore.

Illinois State Electrical Association—Hotel Abraham Lincoln, Springfield, March 19-20. George Schwaner, 205 Illinois Mine Workers' Building, Springfield.

Pacific Coast Electrical Association—Commercial Section, Fresno, Calif., March 20-21. G. T. Bigelow, Southern Sierras Power Co., Riverside, Calif.

Southeastern Division, N.E.L.A.—Bon Air-Vanderbilt Hotel, Augusta, Ga. April 15-17. C. M. Kilian, 207 Bona Allen Bldg., Atlanta, Ga.

Middle West Division, N.E.L.A.—Fort Des Moines Hotel, Des Moines, Iowa, April 23-25. Thorne Browne, 1527 Sharp Bldg., Lincoln, Neb.

Southwestern Division, N.E.L.A.—Hot Springs, Ark., May 6-9. S. J. Ballinger, San Antonio Public Service Co., San Antonio, Tex.

American Institute of Electrical Engineers—District meeting, Springfield, Mass., May 7-10; summer convention, Toronto, June 23-27. F. L. Hutchinson, 33 West 39th St., New York.

National Electrical Manufacturers' Association — The Homestead, Hot Springs, Va., May 18-23. E. H. Hubert, 420 Lexington Avenue, New York.

East Central Division, N.E.L.A.—Hotel Statler, Cleveland, May 20-23. D. L. Gaskill, Greenville, Ohio.

American Electrochemical Society — St. Louis, May 29-31. C. G. Fink, Columbia University, New York.

North Central Division, N.E.L.A.—Managerial Section, Alex. Johnson Hotel, Rapid City, S. D., June 11-12. J. W. Lapham, 803 Plymouth Bldg., Minneapolis.

Canadian Electrical Association—Manor Richelieu, Murray Bay, Que., June 11-13. H. M. Lyster, 405 Power Bldg., Montreal.

Pacific Coast Division, N.E.L.A.—San Francisco, June 16-20. S. H. Taylor, 447 Sutter St., San Francisco.

National Electric Light Association—San Francisco, June 16-20. A. J. Marshall, 420 Lexington Avenue, New York.

Edward J. Doyle

Just named as Samuel Insull's successor in the presidency of the Commonwealth Edison Company.

THIRTY-FOUR years is not a long period in which to climb from office boy to president of so great a firm as the Commonwealth Edison Company of Chicago. This is the record of its new executive, Edward J. Doyle, who, born in Chicago in August, 1879, entered the employ of the old Chicago Edison Company in 1896. Mr. Doyle's education was not complete at seventeen. Continuing its pursuit, he became first private secretary to Samuel Insull, then assistant secretary and assistant treasurer of the company in 1913, secretary and treasurer the following year, and in 1924 vice-president in charge of finances, securities and claims. He became concurrently a director and officer of numerous other companies in the Insull utility group.

Mr. Doyle, in addition to his proved executive ability, has the faculty of winning and keeping the hearty good will of those with whom he works and comes into contact, and his selection for so important a post will meet with wide approval. The change, Mr. Insull announces, is made in pursuance of a policy to bring the younger men of the organization forward in executive responsibility and thus to insure continuity of management so far as possible. Mr. Insull himself, he makes it clear, is not laying down his chieftaincy, but continues as chairman of the board.

EDITORIALS

L.W.W. MORROW
Editor

What Is Their Program?

WHAT are the objects of the political agitators now attacking the light and power industry? Why have they tuned their vacuum-tube amplifiers to exaggerate the minor errors of commission and omission inevitable in the rapid growth of a big industry? Why are they seeking to undermine the confidence of the public in the industry and consequently its ability to go forward and supply needed electric service to the country? What is the tangible program they propose?

It is not government ownership of the utilities—this would lead the agitators to political oblivion. Do they desire to kill all state regulation? Apparently not, although they create a false public impression that state regulation has failed. Nor will they go on record as advocating complete federal regulation. They know not what they want. Some are unconscious agents of a radical socialistic group and others are merely enjoying the sport of bear baiting. There is nothing constructive in their minds.

It is the fashion of the day to discard old standards and old traditions. Through the social, political and business world there is a restless spirit that is cultivated avidly by those who seek political or personal advantages. The Supreme Court, state commissions, the light and power industry and existing social and moral standards make splendid targets for agitators to shoot at. Where speech is free—and who would suppress it?—agitators will abound. Can the American public be trusted to separate the true from the false in the destructive criticism spread before it? Is there reason for fear that we are headed unconsciously toward Soviet ideals through the slow working of a mass psychology formed by the disciples of Marx and Lenin?

It is a difficult situation for the light and power industry to meet. There is nothing tangible in the attack—it is innuendo and insinuation applied to minor aspects of the business. Yet gradually there has come about a situation whereby the utilities cannot gain a fair public hearing and whereby the words "lobby" and "power trust" are sufficient to stifle the most sincere expressions of men who know the business. Only sensation is news for public consumption. Thus the utilities are unheard, the commissioners are unheard and the agitator has the limelight. Few even of the thinking men of America understand the utility business, nor can the people learn about it quickly and readily. It is inevitable that their judgment will be swayed in the wrong direction by the newspaper material that is supplied daily from Washington and from states where legislators follow the example of the politicians in the Capital City. It is the story of the railroad repeated under worse political conditions.

What can be done? Force the political agitators to go on record with tangible proposals and develop a sane understanding of the business in the minds of the people? But who can do these things? And how should they be done? Some agency or method must be devised to get the attention of the thinking leaders of the country focused on the situation. There is a great public interest at stake—far greater than a selfish defense of the private capital now involved in the utility business. Electric service must go forward if the country is to prosper. No more serious or potentially dangerous threat to national welfare can be found than the present drift in public sentiment with respect to electric utilities.

Dissension in the Federal Power Commission

UNSATISFACTORY conditions exist in the Federal Power Commission because operating executives do not pull together. The legal, accounting and executive heads dispute as to the work and needs of the commission as it now exists, and, to top it all, Congress has a bill before it providing for the appointment of full-time commissioners instead of utilizing, as at present, three Cabinet Secretaries in that capacity.

The chief accountant of the present commission wishes to enlarge the accounting function very greatly and to fix the accounts as to form and class for all licensees. The solicitor is desirous to go more fully into the legal aspects of the projects and matters that may bear on rate making. But the executive secretary believes that the law is now carried out quite efficiently and prefers to restrict the activities of the commission to the essential provisions of the federal water-power act. Apparently the Cabinet Secretaries are more or less neutral in opinion and would be willing to step down and "pass the buck" to permanent commissioners.

The Federal Power Commission has done and is doing good work. It is bringing about water-power development under proper safeguards. It is very questionable whether its efficiency would be increased by the substitution of permanent commissioners for the Cabinet Secretaries. This would mean political appointments and an enlarged bureau, for the next step would be the use of a permanent engineering, legal and accounting staff instead of borrowing the experts available in the three governmental departments when needed, as is the present practice. It must be remembered that licensed projects involve less than 4 per cent of the capital and about 6 per cent of the generating capacity of the light and power industry. They are a minor activity in national electrical progress.

It should also be remembered that even were the proposed independent commission set up, the governmental departments of War, the Interior and Agriculture would remain vested with functions affecting the development of water power from streams and on public lands and would not relinquish this jurisdiction. And it should be evident that the public is protected by the provision for valuation at the recapture period, thus making unnecessary complicated auditing and accounting before a license is granted.

If the Cabinet Secretaries will act, they can straighten out the internal organization and eliminate dissension. They can act as quickly and efficiently as could permanent commissioners to uphold the policy and procedure believed best by the executive secretary and the chief engineer. A large bureau is unnecessary and expensive—it would but add another obstacle to prompt decisions.

Evidences of Co-operation in Research

SEVERAL researches of a fundamental character were reported at the recent convention of the American Institute of Electrical Engineers. Additional evidence was brought forward regarding the nature of dielectric loss, and it is now almost universally agreed that this loss is due to anomalous conductivity. This conductivity is high for short-time intervals (of the order of the periods of a wide range of frequency), but decreases rapidly under continuous potential after a second or more. The electrical methods developed for analyzing the well-known variations of oil samples, if extended further, should permit much more intimate knowledge of the relation of chemical structure, chemical change, and especially deterioration. A series of studies of the electric strength of glass, studies controlled in a manner exceptionally close, has shown a remarkable type of variation with temperature and has led the authors to suggest that there are three definitely marked types of electrical breakdown, namely, the disruptive, the thermal and an intermediate region of definitely marked characteristics.

Although no single one of the papers can be said to have brought forward a concrete suggestion for improvement in existing methods, each one of them makes substantial contribution to existing knowledge. They therefore are to be regarded as further additions to the ever-increasing structure of scientific knowledge upon which

the engineer is continually drawing to advance the state of the art.

It is noteworthy that each of these papers emanated from a university laboratory, three of them in the ordinary course of research activities on the part of the faculty and students and two of them under the direction of university faculties with the financial support of the electrical industry, through the National Electric Light Association and the Engineering Foundation. In this group of papers, therefore, we see admirable evidence of the co-operation of the electrical industry and the expert research staffs of educational institutions.

Electrical Influences in the Economic Area Trend

ONE of the interesting developments in the evolution of American industry and business in recent times has been the steady and continuing trend toward a regional unity and consciousness. We are, in fact, no longer so much a nation of so many thousand communities or of forty-eight states as we are a federation of about nine economic areas. The railroad, the telegraph, the telephone, the interurban trolley, the automobile, good roads, radio and the airplane have all contributed to the breaking down of the ancient barriers of separation. And today men think and plan in terms of broad territorial groupings of those several states that are naturally akin because they share so many common resources and traditions—agricultural, industrial, cultural and political and in their history and the character of the people. The location of factories, the organization of distribution, the development of markets is largely guided today by these very present and practical considerations.

The extension of power lines from the town into the country, the linking up of city systems, the tapping of water powers within the region to furnish energy to many towns—all these features of recent electrical development have been typical expressions of the spirit that is animating this new concept of regional unity. There is no better example than in the mountains of the Carolinas and Tennessee, where the high-tension lines have reached the valleys and made it possible to build factories in the very midst of rich labor resources that have been inaccessible until this time.

The experience of New England has proved the value of co-ordination in the development program of an economic area. It puts a stop to unbridled intercity competition for new industries, in which so often extravagant subsidies are offered as bait. It makes it possible to improve the prosperity of existing industries by the study and development of the resources of the region in raw material and labor. It aids in the promotion of a balanced agriculture and the stimulation of various betterment programs. In a word, it applies to the affairs of the area the same benefits that come of intelligent organization in general affairs. Public utility leadership in such a movement can be made a valuable public service.

Commendation Out of Washington

IT IS right and proper that the Federal Trade Commission should demand in its utility investigation tangible evidence of the economies of holding companies. Assuming the merit of the investigation and its justification, such evidence is, after all is said, the center of the inquiry, which simmers down to ascertaining whether or not the advantages outweigh the costs incurred.

There are obvious potential economies. If these have not been demonstrated within a reasonable time, the group of organizations involved have forfeited all claim to immunity from governmental inquiry as to "why the holding company." The American Gas & Electric Company has demonstrated its justification by tangible facts admitted as evidence. Its management and efficiency, moreover, were praised by the engineer for the commission. Thus the first utility to be heard has set the pace for others to follow.

It is to be hoped that the other systems to be examined will produce similar tangible evidence of savings in purchasing, lower costs and better service. It is time for specific data and proof rather than generalized claims and assertions.

Load Division in Interconnections

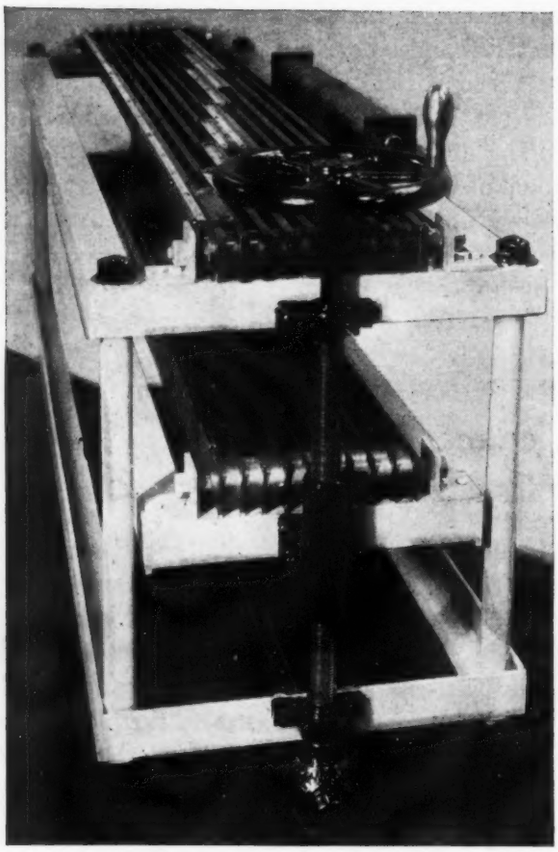


Fig. 1—Instrument to fix generating loads on interconnected systems

VARIOUS methods of load division between stations on an interconnected system are in common use, among them (1) the base-load method, wherein the best station is loaded to its normal maximum and then the next best station, and so forth, the load being reduced in the reverse order; (2) loading all stations successively to their "best point," beginning with the best station and then adding the next best, etc., or under certain conditions bringing them all up to their best load concurrently; (3) the incremental method. This latter method is the scientifically correct method, but it has certain practical limitations in its ultimate application, the overcoming of which it is the general purpose of this article to discuss.

It may be remarked that the approach to the best possible economy of an interconnected system depends on the accuracy of the detailed performance data of its individual boiler, turbine and auxiliary units, and that the expense of obtaining reliable data is compensated for many-fold in the operating economies that can be effected by the application of the data.

Basis of incremental method

The incremental method is based on the principle that after certain required equipment is already in operation and carrying load the next increment of load shall be picked up by that group of boilers, turbines and auxiliaries which will produce the increment for the least added cost. One effect of this is to keep all stations operating progressively at the same increment rate, though they may differ widely in actual heat rate or cost.

To illustrate the effect of various methods of loading the following elementary examples have been set up based on Fig. 2, which shows the heat rate of a typical 200-lb. station and of a typical 400-lb. regenerative station. Taking the methods in the order already stated and a system load of 200 kw. we have:

1. Base-Load Method (Loading best station nearly to full load):

	Kw.		B.t.u.
New station	170,000 at 16,850	=	2,864,500,000
Old station	30,000 at 22,600	=	678,000,000
System	200,000 at 17,713	=	3,542,500,000

2. Best Point Method (Loading both stations near their best points):

	Kw.		B.t.u.
New station	130,000 at 14,850	=	1,930,500,000
Old station	70,000 at 21,500	=	1,505,000,000
System	200,000 at 17,178	=	3,435,500,000

3. Incremental Method:

	Kw.		B.t.u.
New station	140,000 at 15,180	=	2,125,200,000
Old station	60,000 at 21,200	=	1,272,000,000
System	200,000 at 16,986	=	3,397,200,000

Recapitulating:

	B.t.u.	Difference Over Incremental Method	Per Cent Loss Over Incremental Method
1. Base load rate	17,713	727	4.28
2. Best point rate	17,178	192	1.13
3. Incremental method rate	16,886	0	0

By

EDWARD C. M. STAHL

Engineer of Tests Brooklyn Edison Company

THE PROBLEM of obtaining the most economical division of load among interconnected generating stations becomes more involved as the number of stations in the system increases. Additional complications arise where two frequencies are in use and a limited transfer of capacity through frequency changers is possible. If all generating units could feed a common bus, and if the steam from any boiler could be used in any turbine, the problems of economy and capacity would be reasonably simple.

HOWEVER, in practice the boilers and turbines are grouped in separate stations. Each station will have limiting ranges of operation which depend on the total system variation in load, the degree of reliability of the feeders, the importance of the local load and the size of the interconnecting lines, as well as the station's economy characteristics.

IN THIS ARTICLE the author points out how the Brooklyn Company meets the primary requirements of service continuity and also secures the lowest operating cost consistent with this demand.

The foregoing is indicative of the results which may be obtained with the various methods of loading when following a daily load curve and furthermore illustrates the point that loading by the incremental method results in the lowest total heat rate or cost (if cost curves are used in place of heat rate curves).

The lower part of Fig. 2 shows the increment curves derived from the heat rate curves in the upper part of the figure. The points *A* and *A'* show the minimum load (20,000 kw.) to be carried on the old station and *D* and *D'* the minimum load (40,000 kw.) to be carried on the new station. It is evident that beginning with a system load of 60,000 kw. the next 1,000 kw. should be taken by the new station at an increment rate of 12,400 B.t.u. instead of 18,400 B.t.u. on the old station. Each additional 1,000 kw. up to 145,000 kw. on the system should be taken by the new station. This brings the new station up to *E'* on the increment curve and E on its heat rate curve, with a station load of 125,000 kw. From this point on the load should be raised on both stations, keeping the increment rates at the same value throughout the "joint loading range" as indicated. On the heat rate curves the joint loading range is shown heavier, *A*—*B* on the old station and *E*—*F* on the new station.

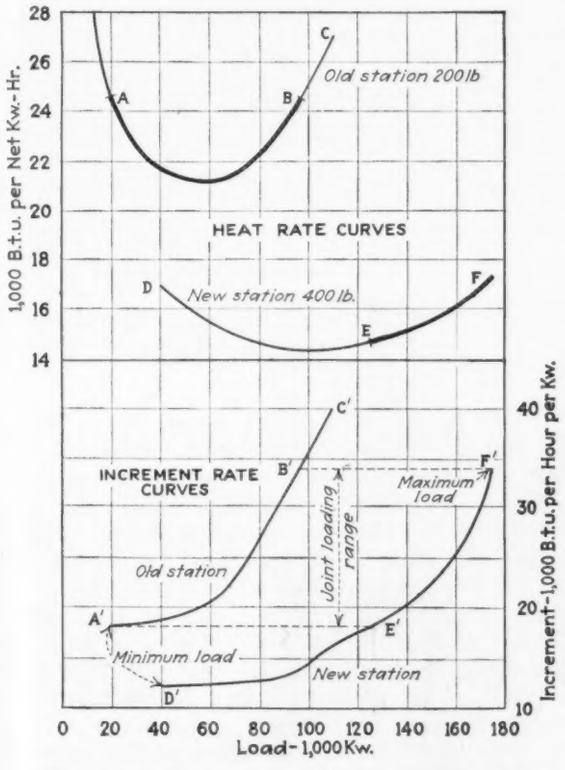


Fig. 2—Heat rates of typical stations

Complicated conditions solved

With only two conditions to consider, as in the illustration, the problem is simple. When there are seven or eight stations, each with only one characteristic heat rate curve, a loading schedule for each station against total system load may be developed without much difficulty. When, however, as in the actual case, each station may have a number of boiler and turbine combinations, any one of which may occur with any combination in other stations, the possible combinations of curves for load division becomes enormous. As a matter of interest, these combinations of boiler and turbine curves, for a case that has been studied, give more than 2,000,000,000. However, by analyzing maximum and minimum con-

ditions and several intermediate conditions a small number of average curves may be used to cover the individual station characteristics. Even with these average curves, which are sufficiently exact for practical purposes, the combinations as a minimum on seven stations give $5 \times 5 \times 5 \times 5 \times 10 \times 20 \times 25 = 3{,}125{,}000$, with a total of only $5 \div 5 \div 5 \div 5 \div 10 \div 20 \div 25 = 75$ curves.

As a practical proposition it is out of the question to work up all of the schedules in advance and it is also inconvenient to prepare schedules after a given system set-up exists. Furthermore, different minimum load requirements exist on some of the stations at different times of the day, so that additional variables are superimposed on the already large number of combinations.

The problem of the standby and peak-load station has certain definite limitations which must be solved separately before applying the incremental method of load division. The principal problem of the standby station is that of ability to pick up load thrown on it suddenly. In metropolitan areas this limitation means that a standby station should be carrying at any time at least one-half the load to which it must immediately pick up. Where the character of the load is such that absolute continuity of the total supply is not essential this ratio may be reduced. Where a station is run over the peak period of only a few hours from no load to full load and down again and is of relatively small capacity its loading will not necessarily follow, and in all probability cannot follow, the normal incremental loading schedule. In this case the load should be dropped off gradually so that the boilers can be reduced in steaming rate slowly enough to prevent waste of heat due to blowing off steam and cooling down after the turbines are off the line.

A typical "family" of heat rate and incremental curves for a section of one station is shown in Fig. 3. The usual method of arriving at a schedule of load division is to plot a group of increment curves, one for each station (see lower part of Fig. 2), and then tabulate the individual station loads at the same increment rates. After this the individual station loads are added to give the system load and another plot made as in Fig. 4, from which system loads at equal intervals may be read off with the corresponding station loads. Unless a great many points are plotted, appreciable errors in load division may result. This method requires the plotting of a set of curves for each combination.

In order to retain the advantages of the incremental method of dividing load for a complicated system the instrument illustrated in Figs. 1 and 6 has been devised.

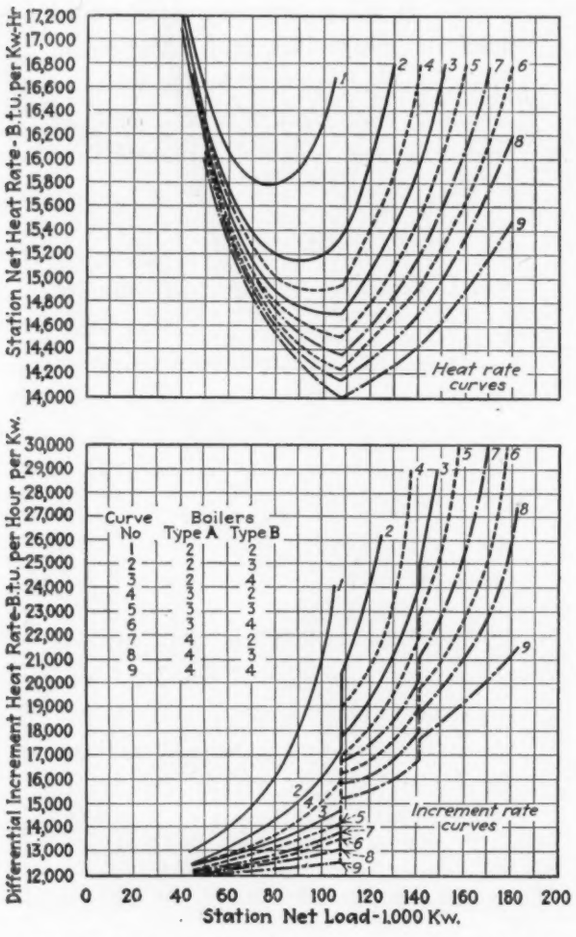

Station Net Heat Rate - B.t.u. per Kw-Hr.
Heat rate curves
Differential Increment Heat Rate-B.t.u. per Hour per Kw.
Curve No
Boilers Type A
Boilers Type B
Increment rate curves
Station Net Load-1,000 Kw.

Fig. 3—A family of heat rate curves for a section of a typical station

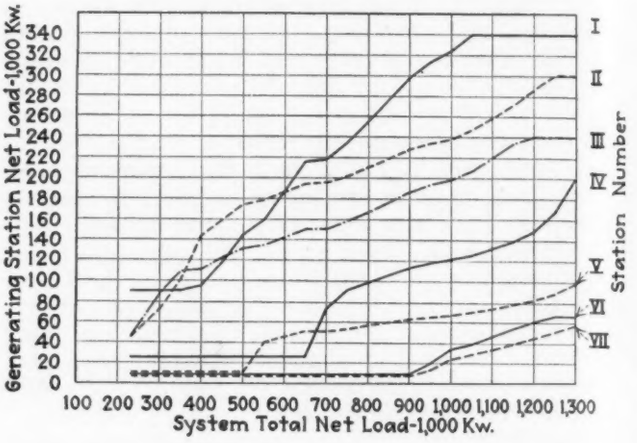


Fig. 4—Loading schedule for a typical station

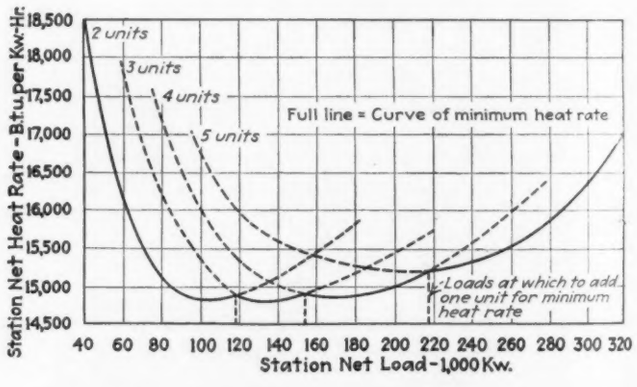

Station Net Heat Rate - B.t.u. per Kw-Hr.
2 units
3 units
4 units
5 units
Full line = Curve of minimum heat rate
Loads at which to add one unit for minimum heat rate
Station Net Load-1,000 Kw.

Fig. 5—Typical station net heat rates showing effect of units on the bus

In addition to the basic division of load it has additional advantages as follows:

1. Show the economical division of load among any number of generating stations at any system load.
2. Show the units which should be running to obtain the minimum generating cost at any load.
3. If the system operator needs additional units for safe operation the instrument can be set up to redivide the load to give minimum generating costs under the required conditions of operation.
4. Divide load to best advantage when any combination of boilers and turbines is used in any of the stations in conjunction with any combination in the other stations.
5. Arbitrarily assign a fixed minimum load to any station and redivide the remainder economically among the other stations.
6. From the standpoint of economy, indicate at various system loads which station should maintain frequency.

In addition to giving every necessary solution for dividing load economically, the instrument will indicate for every one of the combinations the total increment cost at any load and for any coal cost for the entire system.

The foregoing items indicate the information obtainable, all of which in the past required tedious calculations to produce only average results. The instrument gives the information in most cases immediately, or at least within a few minutes and it may be applied to a boiler house only, a turbine room only, to individual turbine and boiler combinations on the whole system or to any combination of stations. Furthermore, it can take into consideration the transmission losses in dividing load between stations having long interconnections.

In cases where there is an appreciable variation in the fuel cost between stations the incremental heat rate curves may be converted into incremental coal cost curves and the load division based directly on coal cost. Furthermore, where total incremental costs (including labor, maintenance, etc.) are available the curves may be developed on this basis. However, it is exceedingly difficult to determine total increment costs, and as coal cost runs from 75 to 90 per cent of the increment cost, the use of coal costs only will give a practical solution.

In order to avoid the impression that the foregoing solutions originate in the instrument, it should be noted that all the computations necessary to prepare the increment curves are required as a preliminary to the use of the instrument. Furthermore, the data on operating procedure and test results must have the same degree of accuracy for all of the stations before the maximum benefit is derived.

The principle underlying the functioning of this instrument is the mechanical addition of abscissas of various station "increment" curves at the same increment rate

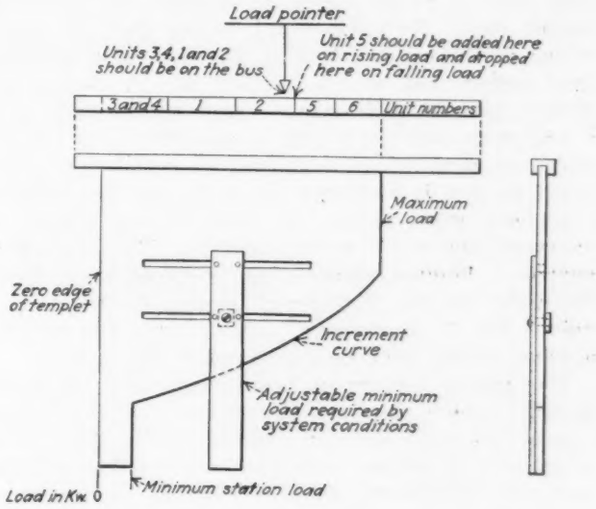


Fig. 7—Templet used in fixing increment loadings

ordinate. Any one of the following types of increment curves may be used: (1) B.t.u.; (2) coal cost; (3) total generating cost; (4) empirical, for certain required operating conditions.

The instrument consists of a frame, with a series of rails side by side mounted along the top. These rails support carriages which carry templets cut to the contour of the selected increment curves. There is one carriage for each station or part of a station having radical differences in equipment.

The templets extend into the space below the carriages and are designed as shown in Fig. 6. A movable table which may be raised or lowered carries another series of rails spaced between the templets. On each of these

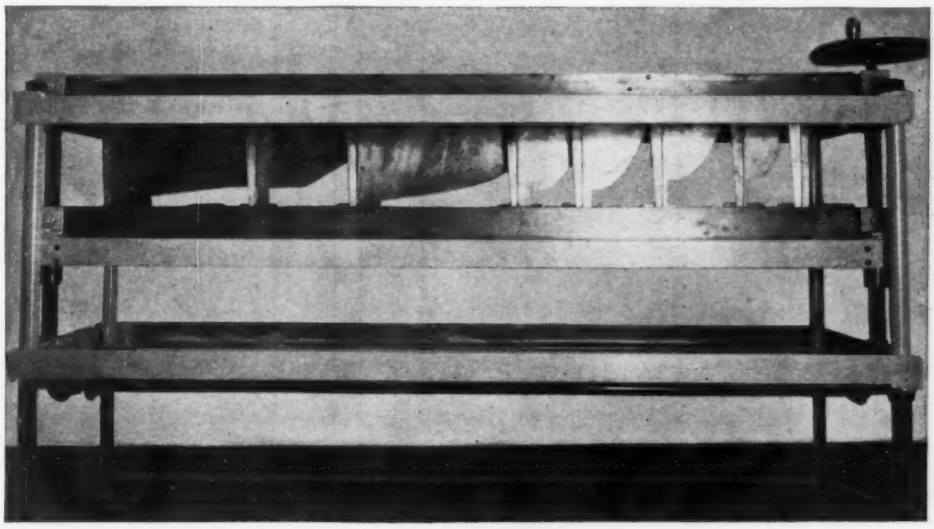


Fig. 6 — Increment rates of loading are readily determined by use of templets

rails a movable separating stylus is mounted which makes contact with the "curve" of one templet and the "zero" line of the adjacent templet. All of these styluses, being mounted at the same height, correspond to the same "incremental rate" on all of the stations, and when all station templets are pushed ahead so that all of the styluses are in contact with a templet on either side, the total abscissa of the staggered templets equals the total system load. By raising or lowering the table and by virtue of the stylus following the increment curve any total system load will be divided into its correct component parts for each station. Each templet carriage has a load scale for the station it represents and a pointer which overlaps the adjacent carriage scale. The pointer is set so that it represents the stylus on the increment curve and gives directly in kilowatts the station load corresponding to the stylus location. The last carriage supports a dummy templet which is required to follow up the stylus on the "outermost" station curve, carry the pointer for the "outermost" station load scale and carry another pointer for the total system load scale.

The present instrument has a range of 2,200,000 kw. system load and the scale is graduated to 1,000 kw. The station load scales are also graduated to 1,000 kw., which is another advantage over the usual loading schedules designed for intervals of 25,000 kw. on the system and 5,000 kw. on individual stations.

A further advantage of the instrument is that the top of the templet is marked to show the range of operation of successively added turbo-generators, so that the station pointer in addition to indicating correct loading shows the machines that should be on the bus and at what loads a given machine should be synchronized or shut down. Fig. 5 shows a set of heat rate curves for various combinations of turbo-generators being served by the same group of boilers. It will be noted that these curves cross each other successively, and it is from these curves that the markings for the templets are derived.

There is also an attachment consisting of a rotating drum and moving pointer which will indicate the system increment B.t.u. rate and for any coal cost the estimated total increment cost on the system.

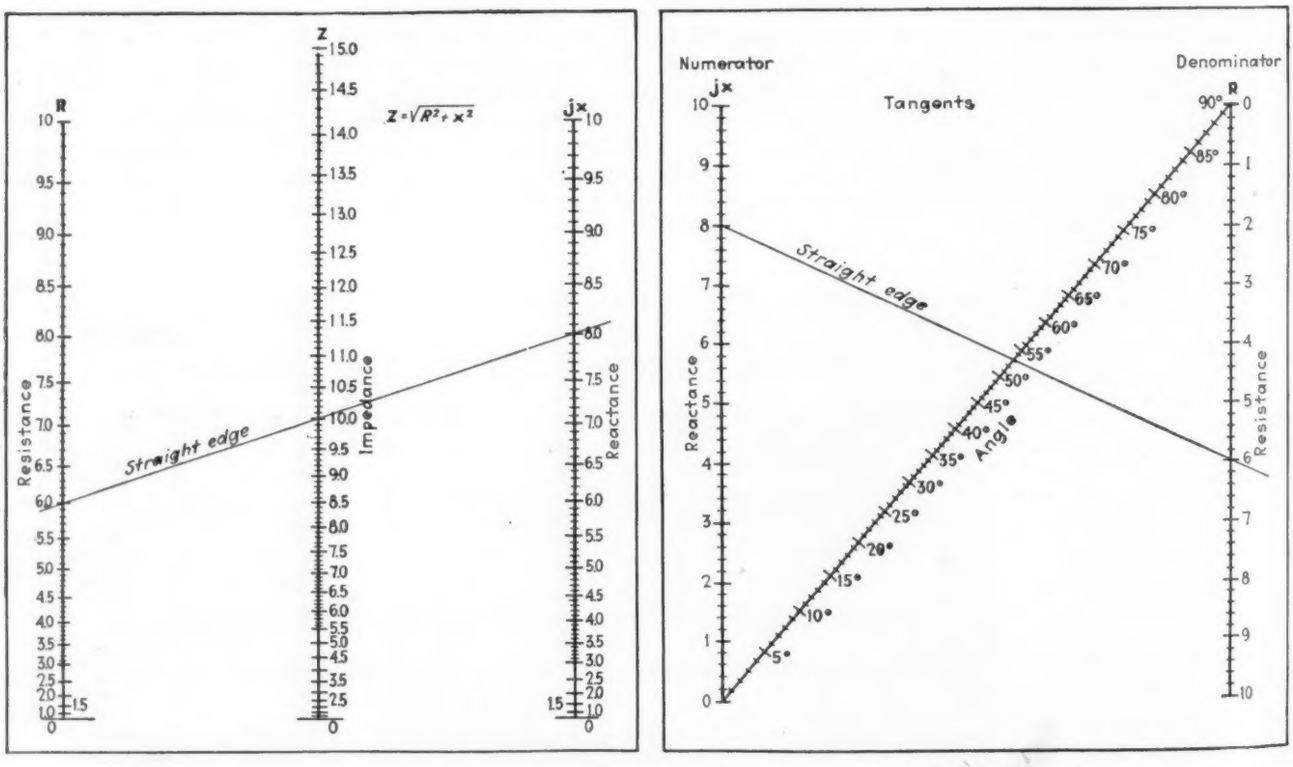
In conclusion, it may be said that the use of the load division instrument permits a practical solution of the complicated problem of operating at all times so as to obtain the lowest total system production cost consistent with safety of operation and continuity of service.

▼ ▼ ▼

Alignment Charts Save Time

By WILLIAM W. EDSON
Station Engineering Department, Boston Edison Company

TO SAVE time in solving right-angle triangle equations involving resistance, reactance and impedance the charts shown in the accompanying illustrations have been developed. Solutions within the usual approximate limits of accuracy required are obtained by placing a straight edge on the charts as indicated. For example, assume a circuit containing 6 ohms resistance and 8 ohms reactance. A line set between these two points determines the total impedance to be 10 ohms, and the corresponding angle of lag is seen to be 53 deg.



Alignment charts show relations of resistance, impedance, reactance and angle of lag

Non-Conduit System Saves in Underground Construction

WHEREVER it is possible, as in industrial plant, street lighting or suburban distribution, to reduce the necessity for expensive permanent conduit runs and substitute less costly expedients it is worth while to weigh the potential advantages as reported upon by the subcommittee on underground distribution in residential territory of the Empire State Gas and Electric Association. They are, first, the close approach of the cheaper types of duct installations to the non-conduit or "Parkway" systems and, second, the favorable light in which backyard secondary distribution is placed. The use of multiple street lighting, however, precludes consideration of rear-lot construction.

"In the past it has been, and is at present," the committee, of which D. C. Lewis is chairman, reports, "the practice of most companies to require reimbursement for a share of the cost of underground construction in the areas under consideration, but the present trend of public opinion seems to predict the need of adopting more definite policies as to elimination of aerial lines, with a resulting closer study of the problems."

Some basic features of the various types of construction were considered as follows:

1. Ducts should be used under road crossings and wide driveways with any type cable. It is the consensus of opinion that duct installation under roadways and drives can be made most economically by the driven pipe method.
2. The location of cable runs under the street pavement, except at crossings, is not advisable in residential districts owing to heavier box and cover construction required. Such work involves standard subway construction rather than the types under consideration.
3. The location of secondary mains on each side of the street facilitates making service connections, and the resulting loop construction gives inherently better regulation with improved voltage conditions.
4. In locating non-conduit cable or duct lines back of the curb, the possibilities of future street widening and cutting back of corners should be carefully considered.
5. Although multiple-conductor cable has the advantages of lower first cost (on the smaller gage conductors), ease of handling and reduced impedance values, there are some conditions which are best met by the use of single-conductor cable.
6. Provision for street-lighting feeders should be made. This is an added point in favor of locating cables on both sides of the street.

*Underground Distribution Costs Compared**

Type of Conduit—With	Initial Cost Index—Type 1 Cable† Lead Covered	Initial Cost Index—Type 2 Cable‡ Braid Secondary
Fiber in concrete	100.0	95.8
Tile	.....	.....
Wrought iron pipe	100.2	96.0
Steel pipe	81.4	77.2
Fiber in earth	76.2	72.0
Pump log in earth	74.6	70.4
Pump log, back-yard secondary	61.4	59.3

	Type 3 Cable¶—Non-conduit
Non-conduit system	66.2
Non-conduit, back-yard secondary	53.6
Aerial construction	10.5

*Transformers not included.

†Type 1—Lead-covered, single-conductor cable throughout, using standard lead sleeve splices. Secondary neutral to be bare conductor.

‡Type 2—Lead-covered, single-conductor primary and street-lighting cable and rubber-insulated, braid-covered, single-conductor secondary cable using bare neutral.

¶Type 3—Non-conduit "Parkway" cable throughout. Three-conductor primary and single-conductor secondary with bare neutral. Wooden, compound-filled splice box used at each service connection.

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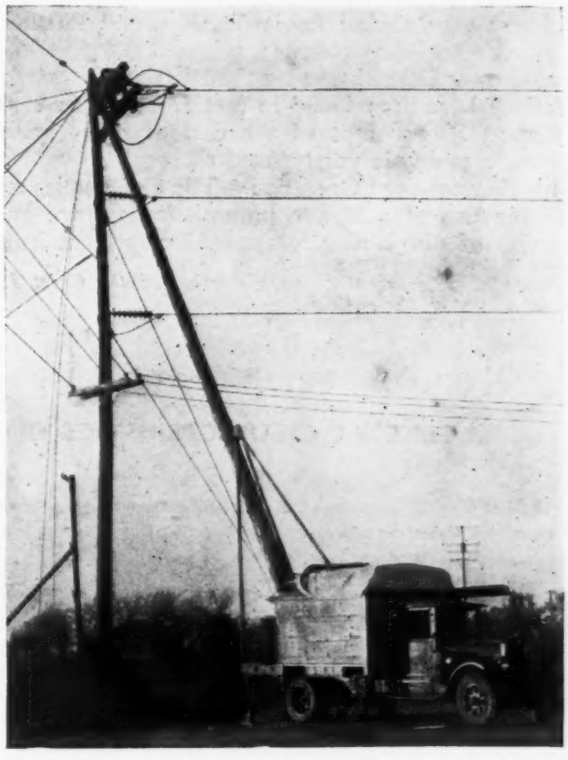
Linemen Avoid Hazard by Climbing Gin Pole



Gin pole permitted working over 10-kv. line

OPERATING ingenuity did some fancy pinch-hitting recently when lightning struck one of the 110-kv. lines of the San Joaquin Light & Power Corporation. The high line was put out of commission, but a 10-kv. line below it was unharmed.

The 10-kv. line served several poultrymen who were hatching or brooding chickens by means of electrical equipment. For this reason it was necessary, if possible, to repair the damages without killing the service line, a hazardous job as the repair required the passing of insulators, wire and hardware through the live 10-kv. line. To kill the line would have been disastrous to the farmers, yet to send men up through it was too dangerous.

Here was where operating ingenuity came in. Instead of sending men up through the lines they went around them. A 50-ft. pole was brought out from Fresno and raised near the line, with the top resting against the pole. The leaning pole was lashed at the top to the high pole, while the base was tied to the tail of the service truck. This made a safe bridge over which the men could pass outside the 10-kv. line without danger.

Networks Prove Themselves in Five Cities*

By R. N. STANLEY and C. T. SINCLAIR
Byllesby Engineering & Management Corporation

THE conclusions reached in this paper from consideration of experience data on operation of alternating-current network in Minneapolis and St. Paul, Minn.; Oklahoma City, Okla.; Louisville, Ky., and Pittsburgh, Pa., are presented as follows:

(a) Lower Cost of Serving the District—Network installations have been found to cost from 80 per cent to as low as 50 per cent of the cost of other systems, effecting a saving in yearly fixed charges.

(b) Economies of Operation.—These economies result from the use of a higher transmission voltage and a reduction of distribution losses. An important item in reducing these losses lies in the possibility of disconnecting feeders with their transformers during light load periods.

(c) Elimination of operation cost in substations.

(d) Elimination of maintenance cost in substations.

(e) The network is capable of almost indefinite expansion within a given area or extension beyond to include greater area. Other radial alternating-current systems, such as throw-over or pick-up schemes, soon reach a state of development where it is not possible to foresee clearly how the ultimate load can be satisfactorily served. This has been found to be due in part to street congestion where the study of a network system for such a situation showed ample space for ducts, manholes and vaults for the ultimate load possible to predict.

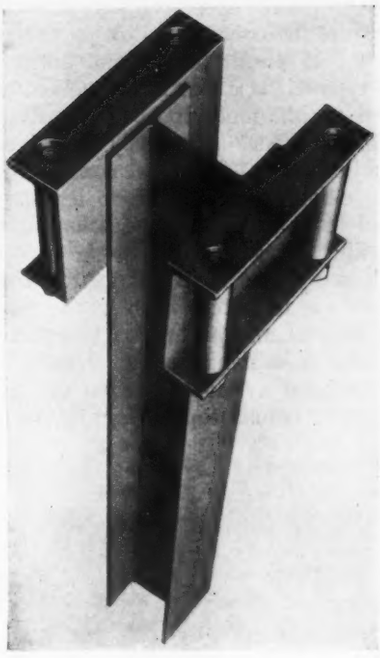
(f) Reliability of Service.—Operating experience for several years by other companies has demonstrated that reliability of service and close voltage regulation can be obtained at lower cost with a.c. network. These experiences have been duplicated on the properties described above, and as further experience is obtained it may be confidently expected that standardization of methods of design will result in further economies of construction and operation and permit giving better service at still lower cost.

**Presented at a recent Chicago meeting of the Great Lakes District section of the A.I.E.E.*

GENERAL CHARACTERISTICS OF STANDARD GAS & ELECTRIC NETWORKS

Subject	Minneapolis	St. Paul	Oklahoma Gas & Electric Company	Louisville Gas & Electric Company	Duquesne Light Company
Area of network present, sq.mi.	0.57	0.125	0.10	0.50	0.50
Present load in network area, kva.	19,300	6,500	4,700	10,000	45,000
Kva. per sq.mi.	34,000	52,000	47,000	20,000	90,000
Load on network, end of 1929, kva.	9,100	1,500	5,800	2,300	22,000
Percentage light and power	Light 70 Power 30	Light 60 Power 40	Light 60 Power 40	Light 52 Power 48	Light 56 Power 44
Number of transformer banks	13.2 kv., 3 phase—16 13.2 kv., 1 phase— 1 4 kv., 1 phase—23	4 kv., 1 phase—20	13.2 kv., 3 phase—9 13.2 kv., 1 phase—21	13.2 kv., 3 phase—16	11 kv., 3 phase—102 11 kv., 1 phase— 43 4 kv., 1 phase— 43
Ratio installed capacity to peak load	2 to 1	3 to 1	1.6 to 1	2.04 to 1	2.68 to 1
Primary voltage	13,200 4,000	13,200 4,000	13,200	13,200	11,000 4,000
Number of primary feeders	2 at 13.2 kv. 2 at 4 kv.	3	3	2	7 at 11 kv. 8 at 4 kv.
Source of supply	2 substa.	2 substa.	1 substa.	Gen. sta.	11 kv. gen. sta. 4 kv. 2 substa.
Feeder regulators	None	Regulators[1]	None	None	None
Secondary voltage[2]	Lt. 115/199 Pr. 230[2]	120/208	120/208	115/199	115/199
Secondary grid	Solid	Sectionalized by fuses[3]	Solid	Solid	Solid
Transformer sizes kva.					
13.2 kv., 3 phase	500 and 300	.....	300	300 and 500	.....
13.2 kv, 1 phase	150	.....	100	.....	.....
11.0 kv., 3 phase	.....	.....	.....	.....	500
11.0 kv., 1 phase	.....	.....	.....	.....	100
2.4 kv., 1 phase	200, 150, 100	100	.....	.....	100
Voltage rating of transformers	13,800–120/208 2,400–120	2,400–120	13,800–120/208	13,200–115/199	11,500–120/208 2,400–120
Transformer impedance	5 per cent inherent + 5 per cent external reactance shunted by fuse	4 per cent inherent	10 per cent inherent	10 per cent inherent	10 per cent inherent on 11 kv. 4 per cent inherent + 6 per cent external reactance on 4 kv.

[1]—Three single-phase regulators on each feeder; compensators not interconnected. These regulators were in use on the old radial system.
[2]—All secondaries are three-phase, four-wire except the power secondary in Minneapolis, which is three-phase, three-wire connected through auto-transformers.
[3]—To be operated with sectionalizing fuses until sufficient short-circuit current is available to make the fuses unnecessary.



The foundation structure

The H - beam extends vertically through the concrete and the ship channels provide a metal base for the pole bearing.

Ornamental Pole Foundations

By L. D. BALE

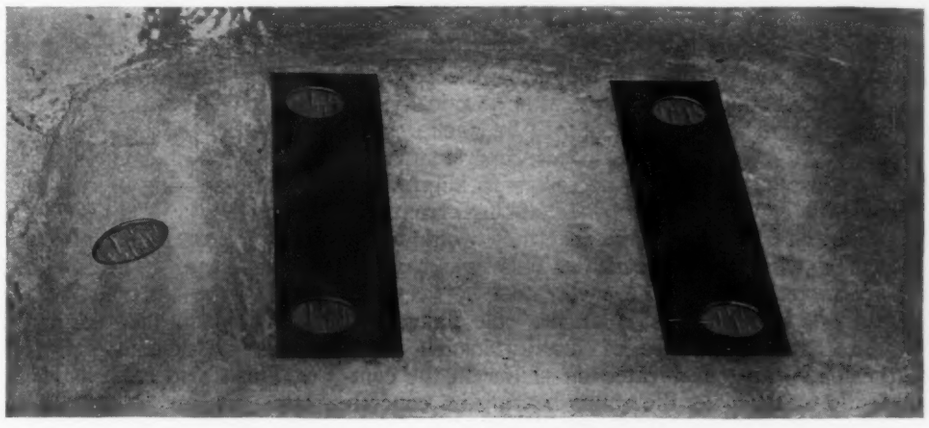
Superintendent of Power
Cleveland Railway Company, Cleveland, Ohio

SAVINGS of from 60 to 75 per cent in the cost of foundations for ornamental poles and standards are being made in Cleveland, Ohio, by the use of a new type of pole base installation. These savings are accompanied by reductions in pole maintenance and improvements in the appearance of finished jobs.

Through mutual action of the city government the Cleveland Railway Company and various civic organizations definite progress is being made in bettering the appearance of some of the most important thoroughfares of Cleveland by eliminating independent structures for the support of trolley systems, white-way street lighting, etc., and substituting a combination, ornamental type of standard accommodating the various utilities. The Cleveland Railway Company has assumed the actual work of making these installations, primarily to insure itself of structures ample for its purposes, and also because it has the equipment available for construction.

In the fall of 1928 there were installed in the Public Square 182 ornamental standards, superseding numerous lighting standards and tubular steel trolley poles. Each of these ornamental standards carries two 3,000-cp. lighting units having a light center of 29 ft. from grade. The side load imposed on these poles from the overhead trolley contact system ran, in many instances, as high as 5,800 lb. applied at the trolley span wire height of 18 ft. 6 in. above grade. Inasmuch as these loads could not be counterbalanced with load applied from the opposite direction, and since the use of head guys was not permissible because of the ornamental nature of the structure, it was necessary to adopt a pole of sufficient strength and to install foundations of adequate size to make the structure, as a whole, self-supporting.

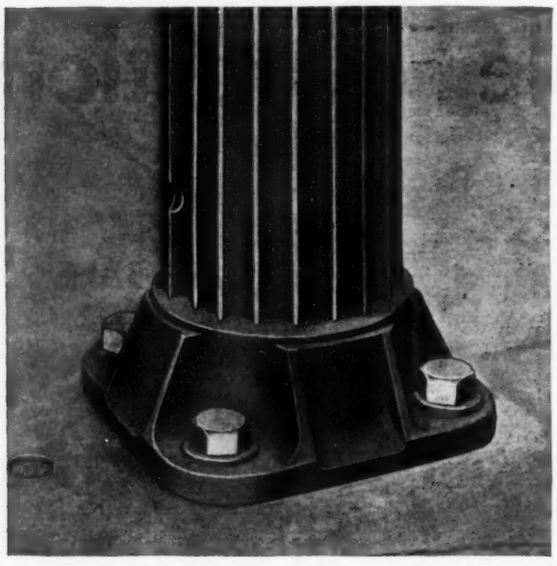
These foundations were of concrete, measuring 36 in. square and varying in depth from 5 ft. 6 in. to 6 ft 6 in., depending upon the nature of the load carried by the pole. Protruding 5 in. above the upper surface of the foundation (finished to sidewalk grade) were four $1\frac{3}{4}$-in. bolts to which the pole was attached.



The finished foundation

The top is above the sidewalk grade sufficiently to prevent collection of water in the pole base. Also there are no protruding bolts to trip pedestrians.

The difficulties encountered in attempting to locate poles, bases or foundations in streets, wherein the poles must be maintained in a given line and location, are many, arising from the multiplicity of underground utility structures, vaults, building basements, walls, etc. The larger the structure or foundation to be placed—that is, the more area it occupies beneath the surface of the street or the sidewalk—the greater the number of obstructions encountered. Quite aside from the cost of such a foundation, due to the rather large volume of concrete and the difficulty of clearing obstructions with the large mass, the presence of the anchor bolts above the surface, exposed until such time as the pole may be mounted, presents a serious accident hazard to pedestrian travel, and, regardless of how well barricades may be maintained, there are always those who will fall over the bolts, accidentally or otherwise.



The pole erected

Pole alignment is assured by shimming between metal bearing surfaces, not metal and concrete.

Difficulty was encountered in mounting the poles on the finished foundations, because it was practically impossible to prevent the movement of the anchor bolts from the vertical during the pouring of concrete. After the poles were mounted it was necessary to align them, or, in the case of poles having load applied from one side, to rake them sufficiently so that they would stand perpendicular when fully loaded. This was accomplished by inserting shims of sheet steel between the foundation and the lower side of the pole flange. It was found that in the case of heavily loaded poles, where the load was concentrated on shims on the compression side of the pole, the shims bearing on concrete laid to sidewalk specifications showed a tendency to disintegrate the concrete, allowing the poles to lean.

Having in mind the various difficulties enumerated, a new type of base has been evolved and is now being installed for the mounting of 126 poles of the same size and type as those previously described for service in the Public Square. This base consists of an 8-in. H-beam section, either 6 ft. or 7 ft. in length (depending upon the load to be applied to the pole), at the upper end of which, and at right angles to the axis of the beam, are welded two 10-in. ship channels. Internally threaded cylinders are mounted between the flanges at each end of the two channels for the reception of bolts which secure the pole flange to the base. The top ends of these threaded cylinders are welded to the under side of the ship channel top angle, and, in addition, are also bolted through the lower flange of the channel for the purpose of distributing the stresses.

The pole complete

The ornamental base wholly covers the top of the foundation.

These H-beam bases are set in concrete in an excavation which is approximately 22 in. in diameter and 6 in. deeper than the length of the H-beam. During the period of setting a templet is used, which supports the bases in an upright position in the hole and enables the establishment of proper location and leveling preceding the pouring of concrete. The tops of the ship channels are set $\frac{1}{4}$ in. higher than the sidewalk grade for the purpose of draining surface water from beneath the pole flange. The concrete is finished flush with the top of the channels, so that, in a completed base, only the two top faces of the ship channel (containing bolt holes in either end) are visible.

This form of construction, which very closely simulates, as far as installation is concerned, the present

method of installing tubular steel poles, has a number of advantages, which may be detailed as follows:

The cost of the complete foundation, including H-beam structure, is from 60 to 75 per cent less than that of the all-concrete base.

The smaller size of the foundation makes it possible to avoid many underground obstacles entirely; further, where large mains or duct lines are encountered, the H-beam steel section may be bent sufficiently to clear the obstruction, without sacrificing the strength of the foundation, and still maintain the desired established alignment of poles on the surface.

The size of the sidewalk opening for the installation of the H-beam is such that it is not necessary to entirely re-lay 25 sq.ft., or, in some instances, 50 sq.ft., as was the case in the former design. These openings may be kept small enough to be covered by the base flange of the standard when erected, even in cases where no ornamental base is used. When an ornamental base is used, however, more than sufficient coverage is obtained.

The mounting of the pole is made extremely simple by the satisfactory disposition of the bolt-shifting trouble, four men and a derrick truck being able to raise and secure a pole on its foundation in ten to fifteen minutes.

Construction combines safety and future-need features

With the elimination of the protruding bolts the presence of the base offers no accident hazard and it is, therefore, unnecessary to maintain barricades and watchmen until such time as the poles are mounted, thus permitting the installation of the poles upon the bases to be delayed indefinitely, if desired. As a matter of interest, the Cleveland Railway Company has actually installed this type of base in a grade elimination project where there will be no poles erected for a matter of possibly four or five years.

Any shims installed beneath the pole for the purpose of aligning will rest between the flange of the pole and the top of the steel channels; thus two hard, true surfaces are present to work on and the concentration of load on points of finished concrete is completely obviated. The alignment of the structure may be maintained throughout its life by the rearrangement of the shims between the flange of the pole and the steel channels. The effect of a change in loading on the structure or settlement of the foundation may thus be counteracted with comparative ease. In the event it becomes necessary to relocate a pole mounted on the new type base, the H-beam may be salvaged and reused, while with the former construction an entirely new base would be necessary, and likewise much of the old base would, of necessity, have to be removed.

Oil Pressure Connections to High-Tension Joints

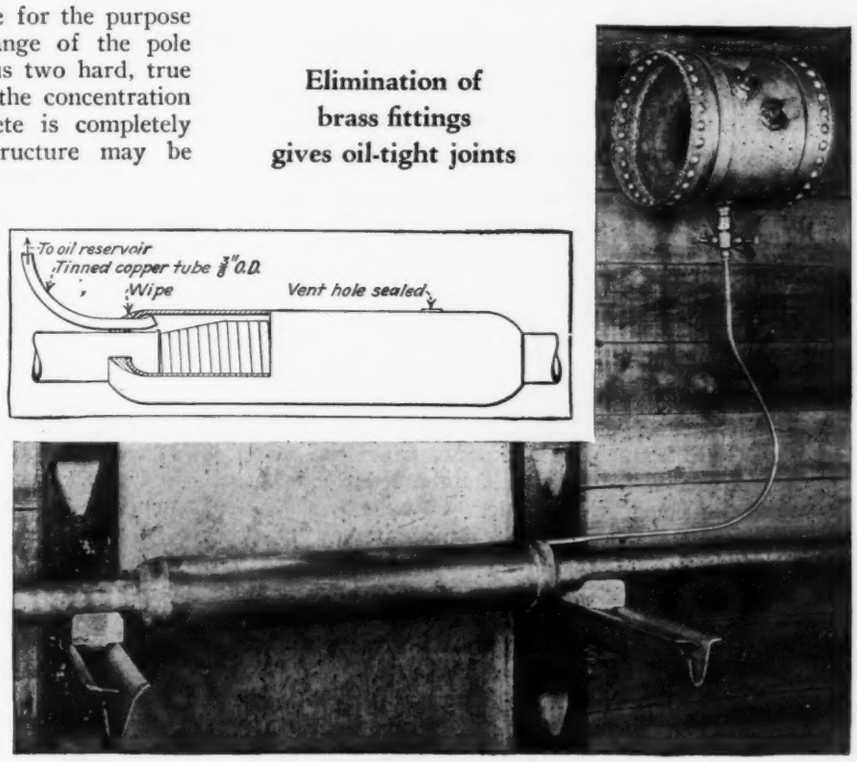
By C. P. XENIS
Division Engineer
Transmission and Distribution Department,
New York Edison Company

ON HIGH-TENSION cable installations requiring the maintenance of oil pressure in the cable joints it is necessary to connect to the lead sleeve of the joint a copper tube leading to the oil reservoir. Brass fittings attached to the lead sleeve are now generally used to make this connection. These fittings are expensive and in a number of cases have given trouble because of leaks. The method shown in the accompanying illustrations has been tested and found satisfactory, simple and economical. It eliminates the need for brass fittings on lead sleeves.

A hole is drilled through the end of the "beaten down" sleeve, the copper tubing properly inserted through this hole and the wipe made in the usual way. The presence of the copper tube does not introduce any special difficulty in wiping. If desired, the wipes may be tested by the use of carbon dioxide or other gases applied under pressure through the copper tube.

The joint is filled with oil through the copper tube until the oil begins to flow out through a temporary opening on top of the sleeve. The oil pressure is then released and the opening in the sleeve closed by soldering in the usual way, so that permanent oil pressure may be applied.

Elimination of brass fittings gives oil-tight joints



Hell Gate Station Design

By W. E. CALDWELL

Research Engineer
The United Electric Light & Power Company
New York

EXTENSIONS to existing power stations involve many engineering and economic considerations, yet it is economical to build power plants by the increment addition method. Thus the original design must take into consideration future needs and changes in the art and equipment.

THIS ARTICLE deals very completely with the problems encountered in adding generating capacity to a large metropolitan power station. The original design was for comparatively low steam pressure and comparatively small generating units. The latest additions involved very large and economical generating units. The author discusses the problems involved and their solution.

IT IS a fundamental factor to get station investment charges to a minimum by using the largest unit equipment. The principles involved in the Hell Gate additions are applicable to large and small stations.

IN THESE days of large-scale power development the addition of a generating unit or extension to an existing plant is usually viewed as an undertaking of minor importance. In the case of the latest two units at Hell Gate, however, the amount of capacity added actually exceeded the expected ultimate development at the time the plant was designed.

The station was initially designed for an ultimate capacity of 310,000 kw. in eight units, while the last two units, recently placed in operation, have a combined capacity of 320,000 kw., making a total installed capacity of 605,000 kw. This article relates principally to the engineering features of the recently completed project outlined as the 1928-29 installation and comprising the American Brown Boveri and Westinghouse units Nos. 8 and 9, each of 160,000 kw. capacity.

The first unit in Hell Gate station was placed in service during November, 1921, at which time the station contained two 60-cycle Westinghouse tandem-compound turbines of 40,000 kw. capacity and two 25-cycle General Electric turbines of 35,000-kw. capacity. Steam was supplied by twelve 1,890-hp. Springfield boilers, each fired by two Taylor underfeed stokers with a double-ended arrangement and central clinker pit. At the time the station was built it was anticipated that this general scheme would be carried out so far as increments of turbine capacity were concerned.

The next unit which was installed was a 25-cycle General Electric unit practically duplicating the previous 25-cycle units. The boilers for this unit, however, were fired by single underfeed stokers having 33 tuyères and water-cooled side walls in the furnace. This was the first installation anywhere in which this type of water-cooled furnace wall was adopted. The boilers for this unit contained less surface than the original installation and were provided with economizers. The long stoker was not available at the time the original stokers were installed, or rather had not passed the experimental stage at this time, but had developed during the period intervening between the first and second installation. By the time units Nos. 6 and 7 were required it was found desirable, for economic reasons, to provide greater capacity in the space which was available and two 60-cycle Westinghouse machines of 50,000 kw. each were installed. Boiler units for supplying these turbines with steam were substantially of the same general design as the previous installation; that is, they were equipped with single underfeed stokers, water-cooled furnace walls and economizers. It had been learned from earlier experience that boilers were capable of much greater output than that delivered by the conventional boiler and stoker combinations used in earlier plants. Economic conditions dictated that the ratio of grate surface to boiler surface should be substantially increased over the pre-

vailing practice. As a result the boiler surface provided per unit of turbine capacity in Hell Gate station was less than that provided in most other stations and necessitated high sustained boiler ratings.

At the time of the initial installation the building was completed to accommodate what was believed at that time to be the ultimate installation of eight units and 24 boilers. By the time the load conditions required the installation of unit No. 8 noteworthy advances in the art had taken place and due to economic reasons it was decided to install the largest unit which could be accommodated in the available space. This was found to be approximately 160,000 kw. capacity arranged in a cross-compound machine.

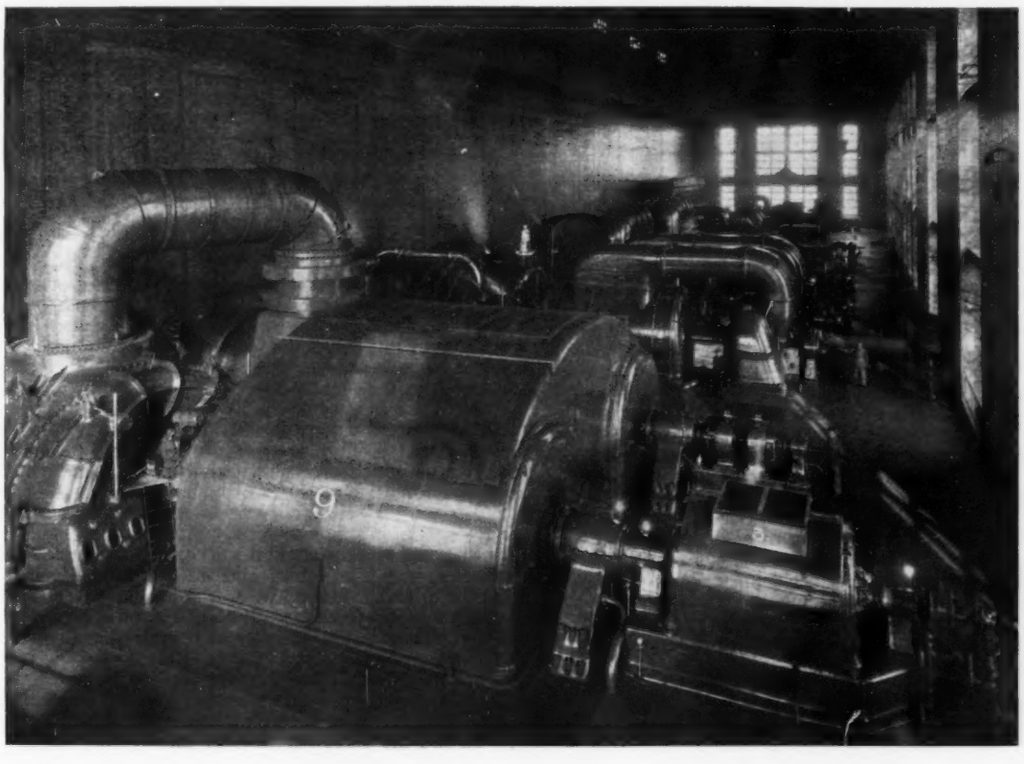
The choice of tandem-compound, 60-cycle units for the initial installation was fixed by economic conditions and manufacturing limitations existing at that time. These were the largest single-shaft units constructed up to that time and the design incorporated features conducive to the best economy. The tandem arrangement necessitated a wide turbine room, at the expense of the width of the boiler room. The wide turbine room made possible the subsequent installation of the 160,000-kw. unit with the cross-compound arrangement, but serious obstacles had to be overcome in installing this unit in space originally provided for a 40,000-kw. machine. However, a single unit of 160,000-kw. capacity is somewhat inflexible on a system in which the other units are of much smaller capacity. As an additional unit or a new plant would be required in the very near future, unit No. 9, another 160,000-kw. machine, was decided upon. To accommodate this unit it was necessary to extend the existing turbine room and make other changes required for the installation of this machine and its auxiliaries. The first 160,000-kw. unit (No. 8) is an American Brown Boveri machine, but was constructed in Switzerland, while the second unit (No. 9) is a Westinghouse machine.

The new turbines are designed for a steam pressure of 265 lb. gage, which is the pressure available from the existing boiler plant. They are built for a temperature of 750 deg., which is higher than that prevailing at present in the older portion of the plant. Both units are supplied with Westinghouse condensers and auxiliaries.

Description of units

These turbo-generator units have been described in detail in technical publications and for the sake of brevity only a brief outline concerning their design and characteristics is presented on pages 436 and 438.

The station steam pressure is 265 lb. gage, this limit being set by the twelve original boilers, which were built for a maximum pressure of 300 lb. At the time of purchasing the new units studies were made to determine the possible gain which might result from the use of higher pressures on these units. Practical considerations, however, decided in favor of continuing at the original design pressure in order to take advantage of the diversity in boiler steam demand made possible by such an arrangement. The use of higher pressures on these two units would have necessitated the immediate installation of a high-pressure boiler plant capable of supplying the entire capacity of these units besides introducing serious operating complications and loss of flexibility in boiler room control. Operating experience with the older turbines in the plant had indicated that serious erosion and excessive turbine maintenance might be expected if the pressure was raised materially without raising the temperature beyond the recognized safe limits of present practice. Space limits and consideration of capital investment combined with other factors to exclude any thought of higher pressure for these units.



Turbine room, units Nos. 8 and 9 in foreground

While the new turbines have been designed for the same pressure as the older installation they have been built for a much higher temperature. The initial installation was built for 600 deg. steam, which was considered high at the time, whereas units Nos. 8 and 9 are designed for 750 deg. steam.

After the purchase of units Nos. 8 and 9 the older turbines of the plant were modified during routine repair and reblading periods so that they are now suitable for use with steam temperatures of 700 deg. and above. It is expected that ultimately the entire plant will be on a 700 deg. basis after plans for additional boiler capacity through the addition of new boilers and changes to increase the capacity of the existing boilers have been completed.

This program permits improving the over-all plant economy quite materially, while enjoying the diversity which results through possible combinations between turbine and boiler capacity where a uniform pressure prevails. Plant operation is also simplified, which was a

TWO UNUSUAL TURBO-GENERATORS

Brown Boveri Unit No. 8.

Unit No. 8, manufactured by the American Brown Boveri Company in Baden, Switzerland, is a reaction type, cross-compound machine. The single-flow, high-pressure element operates at 1,800 r.p.m. and drives a 75,000-kw., 85 per cent power-factor, 13,800-volt generator. The double-flow, low-pressure unit operates at 1,200 r.p.m. and drives an 85,000-kw., 85 per cent power factor, 13,800-volt generator. The generators are connected together electrically and are operated as a single unit, although two sets of conductors and oil switches are employed due to the capacity of the unit exceeding the capacity of the switch mechanisms and compartments which were available.

For the Brown Boveri unit each generator is ventilated by a fan driven direct from the shaft beyond the outboard bearings. This design permits the use of a more efficient fan than is ordinarily employed for this work since the diameter of the rotor is not fixed by the size of the field.

An interesting feature of these ventilating fans, aside from their design, is the light-weight vanes of magnesium which were employed in the construction of the rotor, the purpose being to permit a diameter favorable to high pressure and efficiency without introducing excessive centrifugal stresses. Beyond the fan is the direct-connected exciter for each generator. Voltage control is obtained by means of a rheostat in the exciter field circuit of each machine. Both the high and low pressure generators are provided with separate ammeters and power factor meters in order that cross-currents between the units may be eliminated by means of the exciter field rheostats. An interesting feature of the generator design is the non-magnetic end bells which are made of aluminum.

The turbine is provided with three bleed steam openings for heating feed water, but only the two lower bleed points are used. There are four steam inlet valves mounted on a special chest operated in connection with the governor and oil relay system. At 60,000 kw. two valves are wide open and at 100,000 kw. all four are wide open. When the load exceeds 100,000. kw. steam is by-passed to the lower stages of the high-pressure rotor by means of by-pass valves operating in connection with the governor system. The diameter of the last wheels in the low-pressure turbine, including blades, is, roughly, 16 ft. and the blade length is 38 in.

The turbine is designed for a very flat steam consumption curve due to the nature of system load variations and operating practices. A sacrifice of about 2 per cent in efficiency at the best point was necessary to secure this characteristic. Under actual system conditions, however, the gain in performance due to prolonged periods of fractional load operation greatly overshadows this apparent loss.

The complete machine was built in Baden, which made it necessary to divide the larger parts of the unit for railway transportation from the works in Switzerland to the European seaport. While the preparation and transportation of this unit was an undertaking of considerable magnitude, every part was delivered to the plant within fifteen days after loading abroad, without accident or damage. The successful culmination of this undertaking reflects the careful thought which had been given to the project, and considered as a transportation problem alone it stands as a commendable achievement.

Westinghouse Unit No. 9.

Unit No. 9, manufactured by the Westinghouse company, is a combination impulse reaction type, cross-compound machine. The single-flow, high-pressure impulse reaction element operates at 1,800 r.p.m. and drives an 80,000-kw., 85 per cent power-factor, 13,800-volt generator. The double-flow, low-pressure reaction unit also operates at 1,800 r.p.m. and drives an 80,000-kw., 85 per cent power-factor, 13,800-volt generator. In addition to the main generator the low-pressure element also drives a 5,000-kw., 2,400-volt auxiliary generator.

Beyond the outboard bearing of the auxiliary generator is an exciter for supplying excitation current to the auxiliary generator. The two main exciters for exciting the fields of the high- and low-pressure generators are driven by the high-pressure element beyond the outboard bearing of the main generator. Both main generators are ventilated by three vertical propeller type motor-driven fans located between the high- and low-pressure generators. This design permits the use of more efficient fans than the ordinary integral fan, since they are not limited by rotor diameter or generator speeds.

On the inlet side of each fan protecting dampers are installed and in the event of failure of any fan its damper closes automatically to prevent reverse circulation and loss of cooling effect to the main generators. Operation of these dampers is accomplished by means of hydraulic pressure produced by a pump on the fan shaft. This pump also supplies oil to the fan bearings. In starting up the dampers are closed and upon reaching a predetermined oil pressure and speed a pressure relay admits oil to the damper cylinder, causing it to open. This method of operation of the dampers eliminates starting difficulties which would arise in the event that manually operated dampers were employed. Due to the extremely high power consumption of propeller type fans on shut-off it is important that the dampers open at the proper time to protect the motors against severe overloads. The damper-operating mechanism meets this condition in an admirable manner.

The main generators are incased in a single housing, very favorable to the efficient distribution of the cooling air. The voltage control and connections to the main bus are the same as described in the case of unit No. 8. One of the interesting features of the generator design is the welded steel construction which was employed. These were the largest generators for 1,800 r.p.m. ever built and the use of welded steel construction of the stators resulted in such reduction in weight and physical dimensions that it was possible to have the generators completely built, assembled and tested in the manufacturer's shop before shipment.

The turbine is provided with three bleed steam openings for heating feed water, but only the two lower bleed openings are used. There are six steam admission valves, the first two of which are connected to separate nozzle chambers. The next two valves communicate with the impulse chamber and the remaining valves communicate with different sections of reaction blading. The unit is designed for a very flat steam consumption curve, best suited to system requirements. The valves and governing mechanism are designed to carry 40,000 kw. on the primary, 82,000 kw. on the primary and secondary, 120,000 kw. on the tertiary and 165,000 kw. on the by-pass when operating with two-stage heating.

The divided flow low-pressure turbine is provided with the Bauman exhaust arrangement. The diameter of the exhaust end of the rotor, including blades, is, roughly, 10.5 ft. and the blade length is 29 in.

factor that was considered along with the other conditions in deciding the pressure for the new units. Aside from the thermal advantages to be gained by increasing the steam temperature on the station a substantial reduction in turbine maintenance is also anticipated. Due to the relatively low initial temperature employed with the earlier units considerable erosion and water cutting has been experienced in the lower stages due to excessive moisture. With increased steam temperature and consequent reduction in moisture to the lower stages erosion will be decreased and turbine outage, with serious maintenance expense from this source, will be greatly reduced.

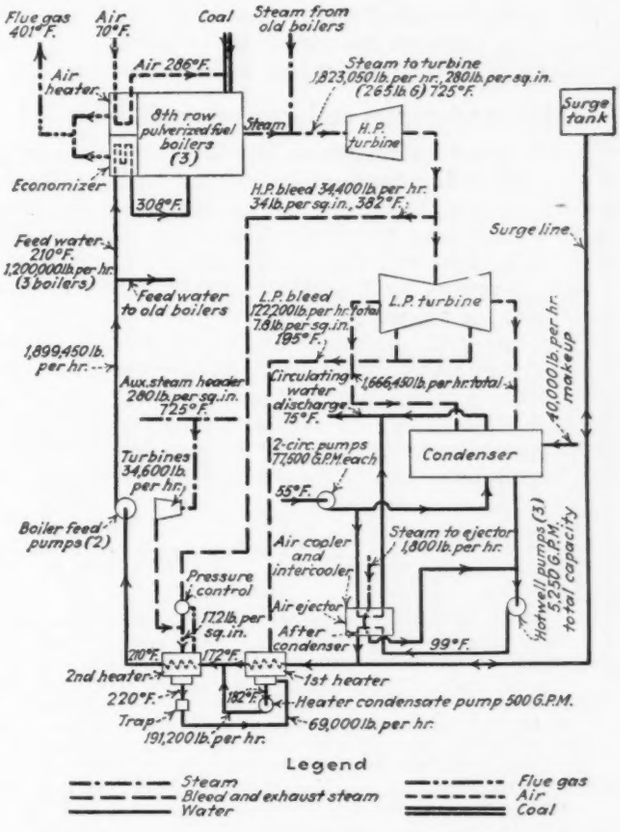
Feedwater system and bleeding arrangement

With units Nos. 8 and 9 the feedwater system followed lines similar to that adopted in the preceding units; that is, two stages of bleeding are employed to give a feedwater temperature of approximately 200 deg. at the feed pump. There is a low-stage bleed heater for each unit which heats the condensate to about 130 deg. under average operating conditions, after which an upper bleed heater adds additional heat to the condensate to bring it up to about 200 deg. at the feed pump suction. This arrangement results in a very simple installation, eliminating any need for high-pressure heaters on the discharge side of the boiler feed pumps. From economic considerations 200 deg. was dictated as the desirable temperature by the economizer installation in the boiler plant. Between the condensate pump and the first heater a surge tank is provided to maintain the desired head on the boiler feed pump suction and to take care of the make-up requirement of the system by means of float control.

On unit No. 8 the bleed connections for the low-stage heater is taken out of the casing above the turbine room floor. This condition practically established the location for the low-stage heater, since steam pressure loss must be avoided to enjoy the full benefit of the bleed arrangement. With the location of the low-stage heaters in the turbine room basement a considerable length of piping, together with fittings, would have been required, resulting in a sacrifice in performance of the combination, to say nothing about the crowding which would have resulted. Inasmuch as the heater itself is not a great deal larger than the connecting piping required for a basement installation it was decided to install this heater in a vertical position adjacent to the low-pressure turbine. The use of two short straight connections near the ends of the heater results in excellent steam distribution in the heater and very low steam pressure drop from the turbine to heater.

Due to the installation of this heater in a vertical position the problem of air removal from the reversing water box at the upper end had to be taken care of in order to secure efficient operation of the heater and realize the full head available from the surge tank. In order to vent this portion of the water space a small tube was introduced through a stuffing box in the lower head of the heater and extended through one of the heater tubes up into the highest point in the floating head. This vent, in turn, is connected into the condenser shell, which exhausts any air that accumulates in the floating head. Since the low-pressure bleed connections on No. 9 unit are located in the bottom of the casing the low-pressure heater for this unit was conveniently installed below the floor in a horizontal position.

The second stage heater for each unit is located in the pump room basement and the condensate after passing this heater flows to the boiler feed pump suction. The second stage heater also receives exhaust steam from the steam-driven boiler feed pumps. The installation of both heaters on the suction side of the boiler feed



Heat flow diagram of Hell Gate for No. 8 unit

Figures indicate quantities or temperatures at 160,000 kw., 28-in. vacuum and 55 deg. circulating water. All pressures in pounds per square inch absolute. Valves are not shown.

pump necessitates careful design to avoid limiting the capacity of the feed pump by reduced submergence on the pump suction. This arrangement, however, has the advantage that it eliminates the necessity for more expensive heaters and higher discharge pressure on the feed pumps. The feedwater system throughout the entire plant may be connected together, either on suction or discharge, except at the older portion of the plant, in which open heaters are employed, and consequently the suction header cannot be opened into the more recent installation.

Due to space limitations single-stage, high-speed, turbine-driven feed pumps are used with No. 8 unit. These compact units are located in the pit with the condensate pumps, which makes available more submergence on the suction than would have been possible if located at the older pump room elevation. This additional submergence is sufficient to protect the pump against unsatisfactory

operation and loss of capacity, for which this type of pump frequently suffers when sufficient consideration has not been given to the suction head. These pumps were designed for a drooping pressure characteristic to insure satisfactory parallel operation with the other feed pumps in the plant.

Due to space limitations it was found economical to install vertical heater condensate pumps. In the location in which they are installed sufficient headroom was available, but floor space was extremely limited. The type of pumps installed were designed especially for condensate, as previous experience with ordinary single-stage pumps on this service had not been favorable.

Heat exchangers and generator air coolers

In the earlier installation at Hell Gate condensate was used as the cooling medium for oil coolers, intercondensers on air ejectors and the other points about the units where cooling was required. The object was to conserve waste heat and prolong the life of the heat exchange apparatus by the substitution of non-corrosive condensate for sea water.

Experience with the use of condensate for this service indicated very undesirable operating characteristics, especially at times of light loads or system disturbances. The condensate system of cooling also introduced certain complications in the operating practice which did not appear warranted by the low-head heat recovery it rendered possible. Pronounced aëration of condensate collected in receiving tanks from some of the smaller heat-exchange apparatus was observed, which is very undesirable in the boiler feed due to the possibility of corrosion. It also appeared in most instances that the additional capital required for extra equipment more than outweighed the gains from heat saving or prolonged life of the heat-exchange apparatus involved. The recovery of waste heat by the condensate reduces the efficiency of the low-stage bleed heater, hence the waste heat covered is but a partial gain. After giving due weight to these factors it was found that it would be more economical to substitute sea water for cooling purposes in the installation under consideration. Sea water has an advantage over condensate in that it is much cooler, which permits a reduction in the physical side of heat-exchange apparatus, such as air coolers, with a consequent saving in space and capital.

All of the generators in the plant are cooled by extended surface air coolers, through which the air is circulated in a closed system. The air coolers receive water from the circulating pump system by taking advantage of the differential head which exists between the circulating pump discharge and condenser discharge. This renders the system simple and self-contained, but requires care in the design owing to the necessity for keeping within the limits fixed by natural laws and the head of water available.

137,500-SQ.FT. CONDENSERS USED

The 137,500-sq.ft. condensers for both units are identical with the exception of the exhaust connections, which are slightly different due to variations in the design of the two turbines. In order to provide sufficient space for the condensing equipment the turbine floor steel was elevated 5 ft. above the floor of the original installation. It was also necessary to excavate a sub-basement to accommodate the condenser and auxiliaries. The sub-basement floor beneath these units is about 10 ft. below that of the old units, necessitating watertight construction and sump pump protection. Due to the large distance between exhaust flanges on the low-pressure units it was necessary to divide the condenser in two parts to avoid condenser tubes of excessive length. This was accomplished by employing a double two-pass condenser combination with inlet and discharge water box between the two condensers and a return water box at the end of each condenser.

The water boxes are divided in a vertical plane with a circulating pump for each half so that the failure of one circulating pump will not result in an interruption to the service of the unit. This follows the same general scheme which was found to be valuable in the original installation. This condenser arrangement has the advantages of having the cold ends at the center between the exhaust outlets, which aids in distributing the steam for securing the best results.

There is a steam-equalizing connection joining the two exhaust connections above the water box to equalize the flow, although normally this should be self-equalizing. A rather unusual feature of the connection to the Brown Boveri unit is the expansion joint. One of the turbine exhausts is bolted rigidly to the condenser nozzle, while the other is connected by means of a thrust-transmitting expansion joint; that is, the turbine exhaust is free to move on steel balls in a horizontal plane, but the steel balls resist any downward motion. A flexible tube is retained between the moving portions of the joint as an air seal.

The condensers combine the features of both the down flow and radial flow type. The tube nest, in addition to being entirely surrounded by a steam belt, is also provided with diverging steam lanes between the rows of tubes. These lanes diverge from the point of air take-off, which is about one-sixth of the way up from the bottom upward and outward to the edge of the tube nest. The tubes below the point of air take-off are provided with steam lanes diverging outward to the lower edge of the nest. The water divides in the central water box and flows through the lower section of tubes first, thus establishing the area of lower pressure in the lower half of the condenser. The air removal boxes as well as the water boxes are divided vertically to permit shutting down one-half of the condenser for cleaning while operating with the other half. A more important advantage of this arrangement, however, is in the greater reliability of operation which is secured by the complete separation of the two circulating pumps so that failure of either pump from any cause will not involve the other or the unit itself.

Atmospheric relief openings are provided in the top section of the condenser shell connected to large atmospheric relief valves and discharge piping carried outside the building.

The condenser tubes are $\frac{7}{8}$-in. O.D., No. 18 BWG, Admiralty metal. They are rolled into the tube plate at the inlet end of each pass and packed with fiber ring and corset lace packing retained by ferrules at the other end.

A 9,000-sq.ft. external air precooler is used to cool the air before it reaches the air ejectors. The air is removed from the precooler by a bank of three-stage steam-jet air ejectors mounted on a single surface type intercooler and aftercondenser. The intercooler surface is divided into two sections, each section receiving cooling water from separate circulating pumps for the purpose of continuing the isolation of the sides of the condenser water supply to insure reliability of operation. Part of the condensate is diverted through the aftercondenser in order to recover the greater part of the heat which is rejected by the steam Jets.

All the circulating pumps are of the centrifugal type direct-connected to the three-phase, 60-cycle, 2,300-volt squirrel-cage motors. The motors are wound for two-speed operation with a capacity of 500 hp. at 290 r.p.m. and 190 hp. at 217 r.p.m. This feature permits operating the pumps at lower capacity during seasons of cold water with a consequent saving in power. The condensate pumps are the centrifugal type, two-stage, direct-connected to squirrel cage induction motors.

While it is desirable to maintain the elevation of the air coolers within 30 ft. of the discharge water level, the size of the new units and auxiliaries combined with existing structural limitations necessitated a compromise here.

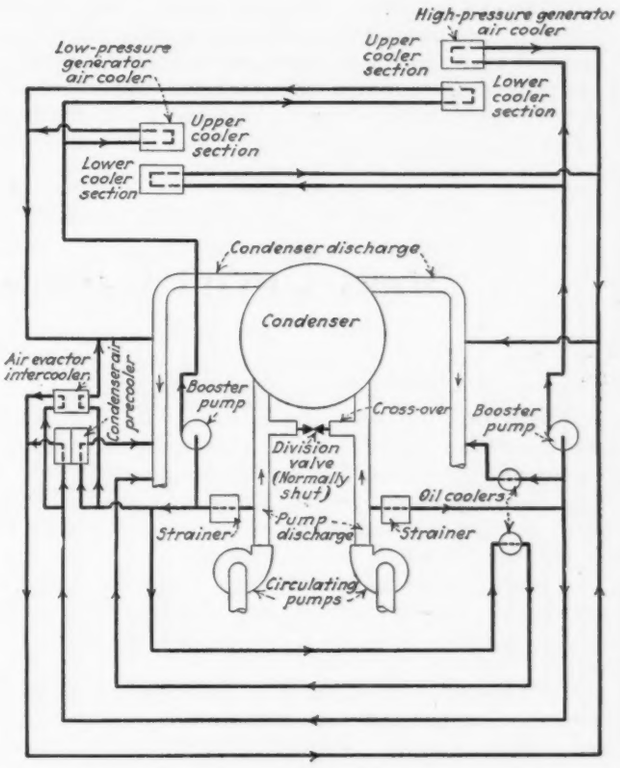
Due to the location of the discharge tunnnel the circulating pump could not be lowered to provide space, which would have been desirable, although it was possible to place the hotwell pumps and other auxiliary apparatus in a pit below the original pump room floor level. It was therefore necessary to locate the air coolers at a height sufficient to meet the ventilating requirements and permit the removal of the rotor from the circulating pump without necessitating the removal of the air coolers, ducts and auxiliaries immediately above. In the case of No. 9 unit the elevation of the air coolers was established by the arrangement of the ventilating fans, motors and ducts, and was even greater than in the case of unit No. 8. The height of the coolers exceeded the desirable height from the standpoint of realizing the full effect of the barometric discharge at low tides and it was necessary to install booster pumps to make up the deficiency.

The booster pumps were installed in the supply line between the circulating pump discharge and the air coolers to make up the deficiency in head due to the partial loss of the barometric discharge. These pumps boost the head about 10 ft. and their driving motors receive power from the same switch which supplies the corresponding circulating pump.

As a reliability precaution the air cooler supply piping is arranged along lines found to provide utmost protection in connection with major condenser auxiliaries, so that the loss or interruption to the service of one circulating pump will not materially affect the operation of the remaining apparatus, except perhaps a slight sacrifice in the economy until this pump can be restored to service. That is, the generator air coolers are arranged in two layers, through which the air passes in series, while the water for each layer is taken from its respective circulating pump discharge. Thus the loss of water to one set of coolers does not materially affect the cooling of the generators, since the remaining cooler, due to the resulting elevation in heat head, has approximately 80 per cent of the cooling effect of the combination.

Inasmuch as there are two generators for each of the larger units care was required in the layout to secure reliability of the combination under any and all operating conditions. The same general scheme is followed in providing cooling water for oil coolers, external air coolers on the condensers and the intercondensers on the steam jet air ejectors. In other words, the entire system, which is dependent upon the condenser and circulating pumps, has been so designed that in the event of failure of either circulating pump driving motor or electrical supply the operating engineer will not be required to operate any valves or make any changes to insure the continued operation of the unit and no haste is required in restoring the circulating pump, which had stopped, to service. The use of cooling water from the circulating system for oil coolers, generator air coolers and similar apparatus saves space and capital investment, since it eliminates the use of a number of small pumps and motors which operate usually at lower efficiency than the main circulating pumps. The starting of the circulating pumps starts circulation through the air coolers and similar heat-rejecting apparatus, greatly simplifying starting and operating procedure.

While the saving of capital investment is worthy of effort, one of the outstanding features which renders this arrangement desirable is in the matter of simplicity and reliability. By the detailed arrangement employed in supplying water to the air coolers the generator is protected against the possibility of water from the air cooler reaching the generator in case of tube failures; that is, the system is so designed that the pressure in the water space is always below atmospheric. Interesting experiences with some of the earlier units in the station justify confidence in the soundness of this arrangement.



Cooling water flow diagram for No. 9 unit in Hell Gate

Valves are not shown.

The ventilating system and air coolers are so arranged that the air passes downward through the coolers and then turns upward to enter the generators. By locating the generator air coolers below the floor this requirement was met in a simple manner. The purpose of this down-flow arrangement is to avoid the possibility of moisture caused by the sweating of the tubes from finding its way to the generator windings. While moisture thus deposited is much less harmful than cooling water which might issue from a hole in a tube under pressure it is nevertheless worthy of consideration. This arrangement provides extreme simplicity and reliability, since it eliminates the necessity for thermostats or tempering connections, often used to prevent sweating. There have been instances when starting up the older units in humid weather that considerable quantities of water, condensed by the air cooler tubes, poured out of the openings at the lower part of the ventilating ducts. The

presence of this water caused no noticeable effect on the generator, and since these experiences sweating of the air coolers is of little concern to the operators. The cooling system is not provided with louvers for open ventilation with the coolers out of service, but for extreme emergency conditions sufficient plate work could be removed from the air duct and the units operated at partial load. However, several years' experience with the older units in the plant having similar cooling arrangement has indicated such reliability that the expense of providing for open ventilation appears unwarranted.

Turbine lubrication is protected against contamination due to cooler leakage by maintaining cooling water pressure less than the oil pressure, so that in the event of leakage cooling water cannot enter the lubricating system. Actually, when leakage occurs there is a slight loss of oil, which may easily be detected by the reservoir level.

It is well known that the presence of water (especially sea water) and high temperature results in sludging of the oil at an accelerated rate. It is the practice of this company to provide a much greater oil-cooling surface than the turbine manufacturers usually recommend in order to limit the temperature of the oil to a safe maximum.

The oil coolers are arranged so that half of the cooling surface receives its water from one circulating pump, while the other half of the surface is supplied by the other pump, the oil, in turn, passing in series over all of the surface.

NOTE: The second part of this article will be published in the next issue of the ELECTRICAL WORLD.

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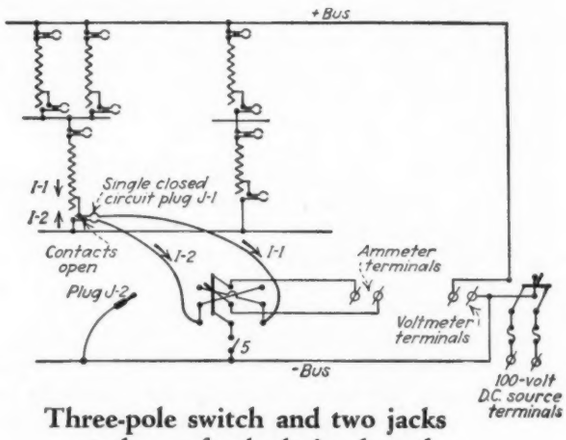
Short-Circuit Calculations at Minimum Cost

BASED upon the assumption that a short-circuit calculating board in which every element is wholly adjustable was not necessary for the particular job at hand, the Winnipeg Electric Company designed and built a semi-adjustable one for its own use. According to E. V. Caton, manager electric utility division, this board, which cost but $200 complete, is wholly satisfactory for the purpose for which it was designed.

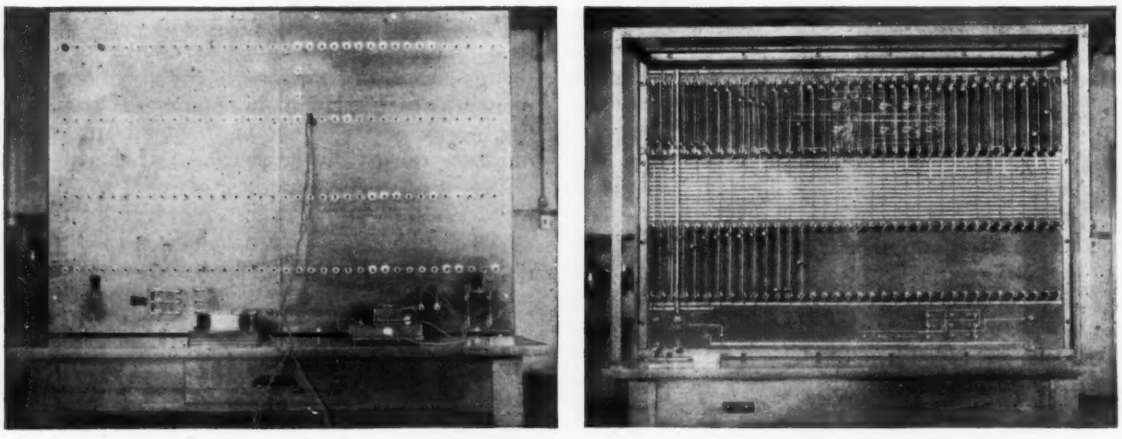
By making a set-up conforming with the existing system and allowing for growth and additions most of the arrangements are permanent and require few alterations to keep the board up to date.

The resistances are adjusted to the relative three-phase impedance of the different circuits and apparatus and were set by accurate Wheatstone bridge measurements. Short circuits may be applied at any point and the various currents read by a milliammeter. This current, multiplied by the known constant, gives the short-circuit current that may be expected on the system.

The three-pole switch on the lower half of the panel is in the ammeter circuit and permits reading the current which flows into the short circuit in either direction to be read. By inserting plug *J*-2 at any point a short circuit is put on the system at this point and by opening switch No. 1 and inserting *J*-1 at different points current flowing at that point may be measured.



Three-pole switch and two jacks speed use of calculating board



Simplicity and low cost features of semi-adjustable short-circuit board

Electric Steam Heating for Large Buildings*

By S. E. MONKHOUSE and L. C. GRANT

DURING the past few years there has been considerable development in the electric heating of buildings, in which radiators and other types of direct heating appliances have played the principal part. One of the largest installations of its kind is at Carliol House in Newcastle-on-Tyne, England. Separate boilers and storage cylinders are used with intermediate calorifiers.† There are two three-phase boilers, each capable of dissipating approximately 1,200 kw. at full load, and these are supplied with current at 6,000 volts from a three-phase, 40-cycle system, each boiler taking approximately 120 amp. per phase.

The boilers deliver steam at 55 lb. per square inch, the steam production being controlled by an electric regulating-valve system which balances the water input against the electrical input, in addition to which there is a pressure-retaining valve which maintains a fixed steam pressure on the boilers and opens only to pass steam to the calorifiers when the pressure exceeds this value.

The calorifiers, of which there are two, so arranged that either or both can be used in conjunction with each of the boilers, are each capable of handling an average steam output equivalent to 650 kw. dissipation.

The two storage cylinders each measures 34 ft. in length and 9 ft. 6 in. in diameter and inclose a total water volume of approximately 4,800 cu.ft., or 30,000 gal. under a pressure of 48 lb. per square inch. Hence at storage temperature (i.e., 230 deg. F.) there are contained in this volume of water approximately 60,000,000 B.t.u., of which about 50,000,000 is available for ordinary use, the balance representing the heat first expended in raising the temperature of the town main water from 50 deg. F. to 100 deg. F.

Temperature Regulation. — The temperature of the water supplying the central heating system is regulated automatically by means of a relay valve system hydraulically operated and controlled by means of a thermostat in the main hot-water flow pipe, so adjusted as to maintain a normal circulating temperature of 110 deg. F. to 120 deg. F., which corresponds to a temperature of 63 deg. F. at all points throughout the building, under all weather conditions. The temperature of the circulating water can be raised to 130 deg. F. for quick heating or emergency conditions.

Consumption. — The building as so far erected is incomplete, but that portion which is in use and has been occupied for two heating seasons has an approximate content of 1,750,000 cu.ft., so that any data so far obtained may be taken as applying when the building is complete.

During the last complete heating period, which was of great severity, an average daily input of 5,300 kw.-hr., i.e., 18,000,000 B.t.u., was required. The average outside temperature during this period was 44.3 deg. F. and the air in the building was maintained at a temperature of 63 deg. F.

The electrical consumption per office of 2,000 cu.ft. capacity was 46 kw.-hr. per week, which at 0.6 cent per kilowatt-hour represents a weekly cost of about 27.6 cents.

The consumption of current in all cases was confined to the period 7 p.m. to 7 a.m.

On the question of maintenance charges there is little to be said. Beyond opening out the boilers for annual inspection, which occupies two days, the only expenditure that has been incurred has been the provision of one set of electrodes at a cost of $25.

Hot-Water Service System.—In addition to the central heating system there is a separate storage cylinder of 1,000 cu.ft. capacity, working under a pressure of 48 lb. per square inch, to supply the domestic hot-water requirements of the building.

This cylinder has a total heat-storage capacity of 15,000,000 B.t.u., of which approximately 11,000,000 are available for use. This cylinder derives its heat from the boiler main steam-range, but it differs from the other storage cylinders in that it is fitted with a calorifier forming an integral part of it.

Steam Costs for Coke vs. Electric Generation Compared

Capital Charges	Coke	Electric
Cost of whole scheme, including domestic hot-water apparatus	$18,000	$28,000
Estimated Annual Charges (Normal Winter)		
Energy—1,100,000 kw.-hr. at 0.6 cent	.....	*6,875
Fuel—500 tons coke at $6.50	3,250	.....
Interest on plant at 6 per cent	1,080	1,650
Depreciation fund on boilerhouse plant:		
Coke—ten years at 7.95 per cent per annum	1,430	.....
Electric—twenty years at 3.02 per cent per annum	.....	845
Maintenance and renewals	750	150
Attendance	2,750	.....
Ash removal	150	.....
Total	$9,410	$9,520

NOTES

(a) These figures do not include the saving on flues and chimneys, which would have cost approximately $10,000.

(b) The capital cost of the electrical installation is high, for the reason that in this case duplication of plant is complete.

(c) At the present time, certain labor charges are incurred with the electrical equipment. These will shortly be eliminated when the complete automatic apparatus has been installed.

* Cost data transferred from pounds sterling to dollars (£1 = $5) accounts for apparent discrepancy, but cost relations are unaffected.

As reported in "The Heating of Buildings Electrically by Means of Thermal Storage," a paper presented at a recent meeting of the Institution of Electrical Engineers (England).

†*A calorifier generally takes the form of a cast-iron drum tubed from end to end after the manner of a surface condenser, with a steam space outside the tubes. The steam from the boilers is passed into the outer space between the tubes, while through the latter the water from the storage cylinder is pumped and so warmed by contact with the steam-heated tubes. During this process the steam becomes condensed and passes from the calorifier through a trap system, thence to a feed or make-up tank to be repumped to the boiler.*

Providing 100 per Cent Space Coverage

EVERY cubic inch of space within the effective travel of the modern electric crane is served in minimum time by taking advantage of such auxiliary equipment as the self-retrieving power supply cable mechanism and the electromagnetic hoist shown herewith. Mechanical limitations have for decades been in process of discard through electrical aids which have extended the working sphere of machinery at relatively small cost in proportion to the benefits realized.

PREVENTING

Inadequate Wiring

By C. ERNEST GREENWOOD

Commercial Director National Electric Light Association

INDUSTRY ACTION has been the watchword in many lines of business. It has helped to place motor cars in ownership of 55 per cent of the families of the nation and more than one car in 10 per cent of all families. *Industry Action* has built up consumption of copper and brass by continuous heralding of the economic advantages through their use in manifold applications; *Industry Action* has taken the bathroom to thousands of farm homes and it has placed varying quantities in each urban home. Scores of equally successful examples of distribution by leading industries could be enumerated.

SOME satisfactory strides have also been made in the electrical industry due to joint or co-operative action in the interest of business building. But great opportunities still lie before us in numerous channels of effort, an important one being the breaking down of resistance to the adequate wiring of commercial buildings.

LAST year there was marked activity in construction east of the Rockies. Statistics tell us that building projects started or contracted for in these states were in excess of five billions of dollars. Half were non-residential, and of this class the commercial type, not including industrial, educational, public buildings and others, accounted for a dollar value of close to three-quarters of a billion. Architects planned more than 70 per cent of this vast group in 1928.

The electrical industry is concerned at the moment with the adequacy of wiring, which is essential to make this commercial type of building of maximum usefulness. There has been no adequate established practice for the wiring of buildings of this class and too often the safety standards for fire prevention have been accepted as models of adequacy.

The situation as the power company men see it to exist is concisely this: The architects have been the masters of equipment in commercial buildings. The power company has been in the position of the repairman. The tenant of the building, or perhaps the owner of the building, calls on the power company on first realization of inadequate electric service, which is quite a natural reaction for a continuous clientele such as all power companies enjoy. The power company primarily acts as investigator of the deficiencies in electric service in a building, and it is the revamping of original wiring installations of insufficient capacity that has given to it information not usually shared by the consultant of new installations.

Experience has indelibly written on the records that the mass of old buildings lack capacity in copper to make modern lighting effects possible; that in a surprising number of buildings of later construction wiring specifications have not allowed for even a five-year growth in lighting practice. Wiring for illumination in some of the newest of our buildings has been found inadequate upon first occupancy. These facts have been forcibly recognized in some of New York's latest "skyscrapers," where several thousand dollars have been spent in new circuits before tenants moved in. Such cases are not exceptional ones.

The absence of marginal copper capacity in commercial wiring installation was nicely covered up over a period of years during which time there was continuous gain in the light output of lamps per watt of energy put in. But for the past six or seven years lamp efficiencies have advanced more slowly, while the demand for more electric light has been accelerated. To complicate the situa-

tion, competitive conditions have resulted in the squeezing of wiring capacities, with the result that when the call for help is answered by the power company, excessive voltage drops are revealed, with lamps operating below their rated efficiency. It is not uncommon to find lamps running 20 to 30 per cent low in candlepower.

Wiring facilities often fall short of the proper allowance for signs for the merchant group on the lower floors, and for the roof signs as well. Notwithstanding the efforts of proponents of civic betterment to eliminate signs, it will be generally agreed that electric signs are here to stay. Architect and power company must act in concert to make them more artistic in design and their settings on buildings more attractive. When space is not left for signs, nor space to run the wiring, the reaction of the tenant is not an agreeable one, and the result is often the marring of the structure.

The vision of Joseph Urban of New York City, who has planned a theater building front of black glass, with fire escape producing modernistic designs on the outer wall and with the platform railings of the fire escape outlining electric signs, can have practical legs put under it. There is the germ of sound ideas in future practice in electric decoration of building exteriors.

SUGGESTED SPECIFICATION PARAGRAPHS

for Commercial and Industrial Building Wiring

EACH of the following suggested specification paragraphs, developed in co-operation with the American Institute of Architects, is intended for insertion under its proper heading in the architect's electrical specifications and is additional to the material that is usually found presented under these headings.

The provisions under "Branch Circuits" are based upon the use of 15-amp. fuses. In the exceptional case, where it is desired to use 30 or 40-amp. circuits, it is suggested that a detailed check be made by a consulting engineer, since such heavy circuits may be more expensive to install and operate than would be a larger number of lower ampere circuits.

Where local ordinances limit the permissible wattage per circuit to less than the capacity of a 15-amp. fuse, it is suggested that the specification paragraphs be restricted correspondingly.

It is understood that the architect or engineer will locate the outlets on the plans. The Franklin specifications of the Society for Electrical Development and the bulletins on illumination design issued by incandescent lamp manufacturers indicate good practice in this connection.

Branch Circuits

In no case shall one branch circuit for overhead lighting supply the lighting for a work space or rentable area greater than 400 sq.ft. or a bay approximately 20 ft. by 20 ft., nor shall one branch circuit for overhead lighting supply more than 800 sq.ft. of hall or passageway or other non-rentable or non-productive area.

Based on the wattage of outlets specified on the plans, branch circuits shall be so arranged that the load on any branch circuit shall not exceed 1,000 watts, except in the case of a single lamp of larger size.

Not less than No. 12 B. & S. gage wire shall be used, either for runs from panelboard to first outlet or for runs between outlets. For runs of 50 to 100 ft. from the panelboard to the first outlet not less than No. 10 B. & S. gage wire shall be used and not less than No. 12 between outlets.

Runs exceeding 100 ft. from the panelboard to the first outlet should be avoided wherever possible by the addition or relocation of panelboards. Where such runs cannot be avoided, the initial lamp load as indicated on the plans shall be limited to 600 watts for each circuit, and wire not smaller than No. 10 B. & S. gage shall be used between the panelboard and first outlet.

Except as in hereinafter specified, convenience outlets shall not be placed on any circuit supplying ceiling lighting outlets. Wall and baseboard convenience outlets, except as otherwise noted, shall be of the duplex type. Not more than six duplex outlets shall be placed on one circuit, using not less than No. 12 B. & S. gage wire where the run from panelboard to first outlet is less than 100 ft., and not less than No. 10 B. & S. gage wire where it exceeds 100 ft.

Panelboards

Panelboards shall contain a minimum of one spare circuit position for each five active circuits or fraction thereof.

(It is generally desirable to specify that all circuit positions be supplied with switches, except for circuits supplying show windows, signs, etc., where a time switch or other automatic switching device is placed in the supply feeder.)

There shall be at least one panelboard on each floor of the building, except as otherwise specified hereafter. Wherever possible, panelboards should be so located that branch circuit runs exceeding 100 ft. to the first outlet can be avoided.

Feeders

The current-carrying capacity of a feeder shall be great enough to supply 10 amp. (115 volts) to every circuit position provided for on the panelboard or boards which it feeds.

The feeders shall be of such size that the voltage drop from the source of supply to the panelboard will not exceed 1½ per cent with a load of 10 amp. (115 volts) on every branch circuit provided for.

Conduits for inclosing feeders shall be of sufficient size to permit replacing the original feeders with wires two standard B. & S. gage sizes greater in capacity.

Show Windows

One branch circuit should be brought into the window for every 5 ft. of plate glass, measured along the horizontal.

Except as noted below, a time switch of proper capacity should be installed in the feeders or sections of panelboard bus supplying show windows. Where this exception is taken, provision should be made for conveniently installing a time switch at a later date.

Signs—on Commercial Buildings

A rigid metallic conduit not smaller than 1 in. trade size should be run to the sign location on the front of the building, as indicated on the plans. (NOTE: Namely, a convenient location above the first floor for each store space.)

Each such conduit shall originate at the show window panelboard, of the corresponding store space, which panelboard shall have four spare branch circuit positions for the sign feed. A 30-amp. 125/250-volt fused and switched panelboard subfeed will be acceptable in place of these four branch circuit positions.

The unsatisfactory conditions in commercial wiring herein outlined are the dual fault of architect and power company. They have not worked together until recent years, when a score or two of power companies introduced a "lighting service" to their local architects. These companies have in their employ men equipped with illuminating engineering experience to enable them to give authoritative advice regarding lighting and wiring appliances. The architects in the community served have been acquainted with this service, a friendly contact has been developed, and highly satisfactory results to architects, building operators, tenants and power companies are the natural outcome.

Attitude of architects

In referring to lighting service offered by the power companies, no less an authority than N. Max Dunning of Chicago, a fellow of the American Institute of Architects, writes:

"I believe that what is being undertaken in lighting service by the power companies is of the very greatest importance, as it is impossible for the average architect to anticipate the developments that are taking place in the science of illumination, and we have many examples before us each day of buildings, only a few years old, that have to be remodeled as to their conduit and wiring systems at a very great expense in order to provide the illumination and electrical facilities that are required by the modern developments of business and of domestic use."

Primarily, the appeal of the lighting service of the power company is directed at problems which are too small for the consulting engineer, or which cannot afford the monetary consideration for the service. It would substitute for extra service previously given by competitive sales interests. The power company feels that such information should pass through the architect instead of other sources that may be influenced in their opinion by interest in the sale of equipment. It is desirable that it should not be given direct to the consumer himself.

Recent committees of the N.E.L.A. have paid considerable attention to the study of the commercial lighting and wiring situation in all classes. They have sensed the need of industry action, investigated the facts and produced "lighting service manuals" for use by commercial departments of the power companies, and are advancing in every way possible the establishment of lighting service to architects in power companies where not now available. The importance of competent illuminating engineering representatives of the power company to assist the local architect in his plans for electric equipment for commercial buildings is being stressed.

The latest development is the preparation of "specification paragraphs" to be included in the wiring specifications of the architect. They are now being promulgated by the National Electric Light Association in a report which will soon be distributed. These "specification paragraphs" suggest quantity features which are the result of experience of power company illuminating engineers. They cover average requirements, and are not intended to apply to monumental buildings, although in some of them they might have been adopted with beneficial results.

Special loads will always require special attention, such as the introduction of modernistic lighting. For example, the new Chanin Building in New York City has adopted a form of lighting in the lobby which requires wiring capacity of 2 watts per square foot, which is about twice usual present practice.

Responsibility to public

The additional cost of an installation on N.E.L.A. specifications might be as high as 1 per cent of the cost of the average building, a minor consideration when expressed in terms of ultimate service to client and tenants, because the cost of providing additional wiring capacity after the completion of the building is so much greater that it is often prohibitive. It happens also that the architect's ideal is often marred or destroyed by makeshift attempts to provide light for utilitarian requirements.

An especially noble principle in the code of "Professional Practice" of the architectural profession reads that the architect "is engaged in a profession which carries with it grave responsibility to the public." Here lies the common interest of power company and architect. The power company likewise has a correspondingly "grave responsibility" to the public. In fact, all its hopes and ambitions are wrapped up in the growth of the communities it serves, the prosperity of the commerce and industry of those communities and the happiness and prosperity of the homes.

Numbered among the commercial and industrial consumers that are served by the power industry are the owners and operators of buildings who consult the architect or engineer as professional adviser. These "advisers" must be fully informed regarding the benefits of light and the essentially important details of planning for adequate electric service for those who the client of the architect will serve.

We of the electrical industry are confident that this service will grow increasingly and constructively helpful. No obligation goes with this lighting service, but through it, the power company seeks to remove resistance to better lighting practice and would join with the architect who has common interest for better service to the commercial public.

The cordial co-operation of the structural service department of the American Institute of Architects in giving association members valuable advice during the development stages is here acknowledged.

Pessimist and Optimist

The most effective regulation of rates in the interest of the consumer is found in publicly owned and operated plants.

NORMAN THOMAS.

The electrical industry should have freedom from interference so long as it serves adequately. The electrical industry is too great and its possibilities too vast to be endangered by minds not geared to modern industrial initiative.

HENRY FORD.

Time-Current Motor Control

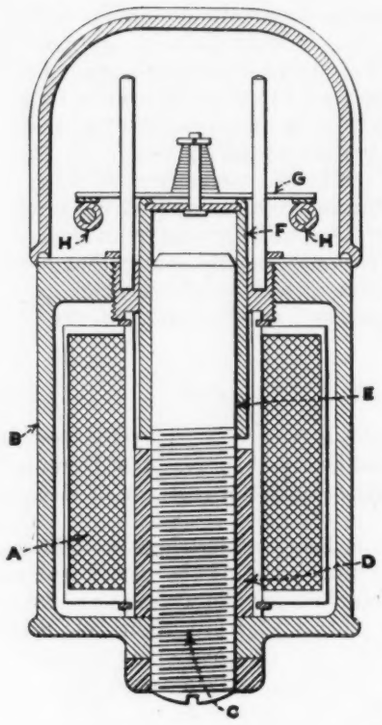
Closure of relay contacts retarded in proportion to current allows motor shorter or longer time to reach speed in starting operation according to load

By H. K. LIEDY
Electric Controller & Manufacturing Company, Cleveland, Ohio

DURING the past year an interesting improvement in the methods for automatic acceleration of direct-current motors was the development of time current control; that is, control in which the time between successive acceleration steps is modified by motor loads. This control will also provide forced acceleration when required.

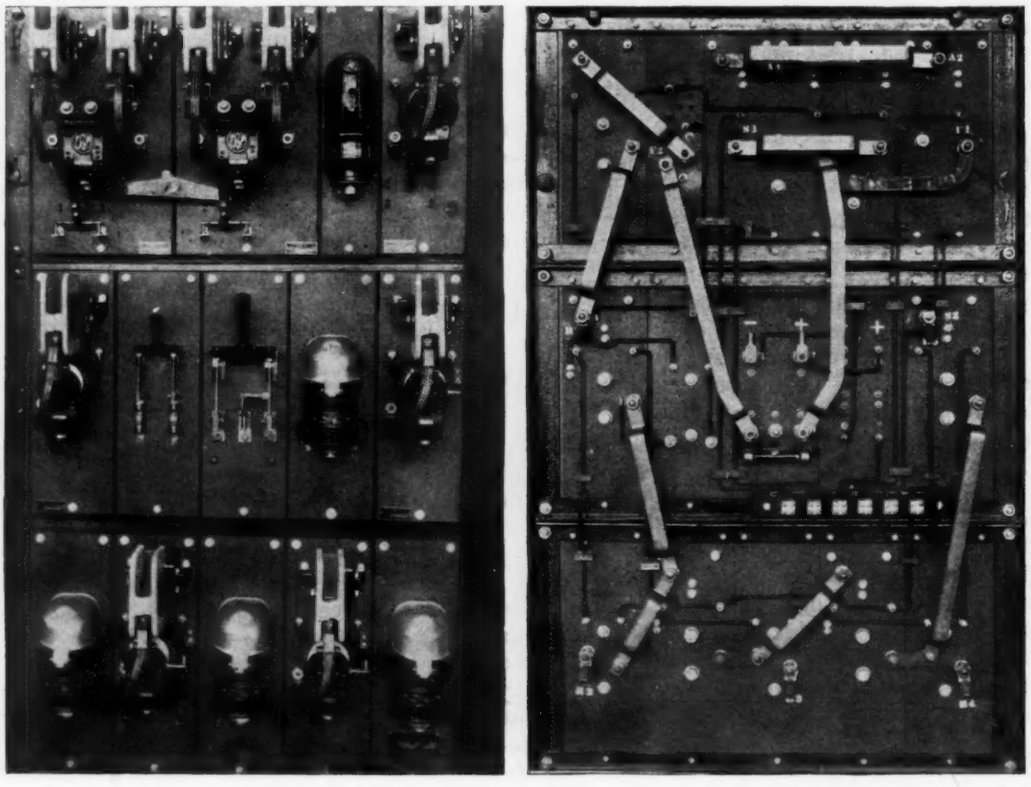
The system is suitable for use on all remote-control direct-current motor drives and also where it is desired to eliminate the human element in starting the motor. There are many applications of this nature to which this control has already been applied, such as steel mill, foundry and general purpose cranes, ore and coal bridges, steel mill drives, blast furnace skip hoists, car dumpers, wire blocks and various conveyor drives.

The variation in accelerating time is automatically accomplished by a simple relay which operates on the inductive principle. The component parts of this relay consist of a series operating coil, an iron inclosing case which is a part of the magnetic circuit, an adjustable steel core, a stationary steel tube and a movable aluminum sleeve which carries a copper contact bar. This bar normally bridges two stationary contacts, completing the circuit to the operating coil of one acceleration contactor. When current is applied to the relay coil, induced current in the aluminum sleeve causes it to rise instantly and then it descends at a speed depending upon the strength of the magnetic field of the coil. This retarding action is similar to the retardation of a wattmeter vane or disk as it is forced through a damping field. Equally interesting is the fact that the aluminum sleeve rubs neither on the central steel core nor the inclosing case as

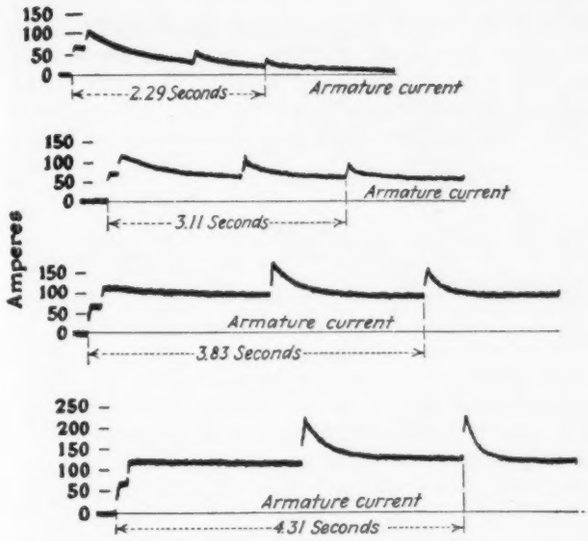


Relation of parts in time-current relay

A—Series operating coil.
B—Iron inclosing case.
C—Adjustable steel core.
D—Stationary steel tube.
E—Aluminum sleeve.
F—Air gap in magnetic field.
G—Contact bar.
H—Stationary contacts.



Front and back of typical time-current control panel



Graph taken from oscillographic records of time-current relay operation

Armature currents of 20-hp., 230-volt mill type motor started by time-current relay under 0, 50, 100 and 150 per cent load. The relay setting remained constant, retardation being caused by increase of armature current.

it rises and falls. This is due to the concentric construction of the relay which causes all magnetic forces to balance each other. This is especially important because it eliminates all wear which might otherwise occur from frequent operation.

A full magnetic controller of the plain reversing type using time current relays is shown in the accompanying illustration. This controller cuts out four steps of resistance in bringing the motor up to speed and uses three time-current relays (with aluminum covers) to control the acceleration contactors. The fourth relay (with aluminum cover) is for plugging and prevents the closing of the plugging contactor, thus protecting the motor from excessive currents, when the controller is rapidly reversed from one direction to the other. However, just as the motor comes to rest or as it starts to accelerate in the opposite direction, this relay again closes, causing the plugging contactor to short out the plugging resistance. When starting up from rest, the plugging contactor closes immediately, allowing the motor to accelerate without delay. Because there are no complicated shunt circuits or resistor units the wiring of a time-current controller is comparatively simple.

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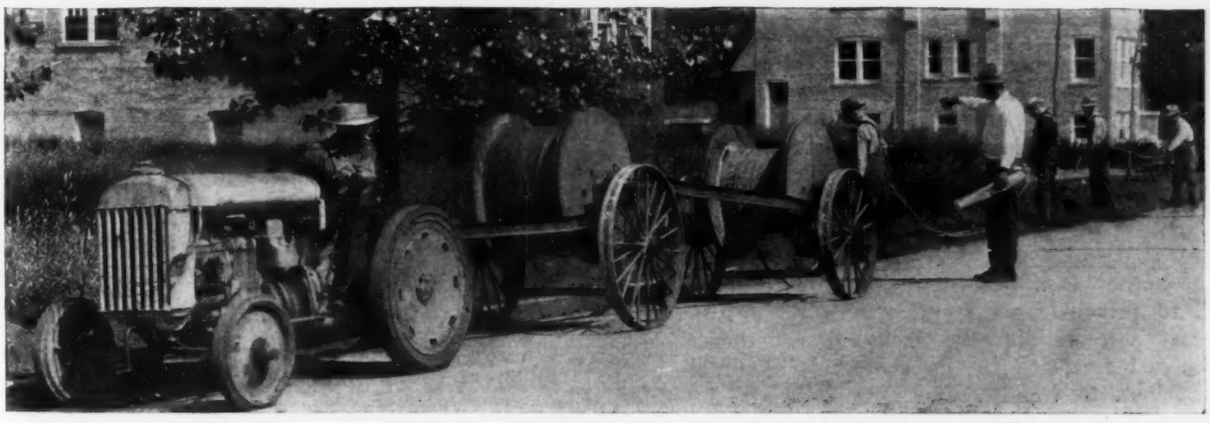
Reel Cart Speeds Laying of Street-Lighting Cable

By R. J. DRAKE
Assistant Street Lighting Engineer
Public Service Company of Northern Illinois, Chicago, Ill.

SOME of the labor-saving equipment utilized by the A. A. Electric Company of Chicago in the installation of a large street-lighting system in Berwyn, Ill., was machinery readily available from manufacturers and some belonged in the category of home-made devices. The cable reel cart here described belongs in the latter class. The contractor was able to obtain several pitch kettle carts, such as are commonly used in street repair work. These carts cost him $10 apiece. By spending about $100 more on each of them he had a pair of very efficient cable reel carriers. A 2,000-ft. reel of cable can be loaded on one of these carts by two men.

The cart is backed up to the cable and a shaft passed through the center of the reel is caught at its ends by a pair of hooks which are continuations of the open end of the cart frame. The tongue of the cart is then pulled down to the ground and the reel is lifted up, sliding forward on the frame until it comes to a position approximately above the axes of the wheels. Pins are then inserted in the frame to hold the shaft in this position and the tongue is raised from the ground, the heavy reel of cable then being quite accurately balanced above the wheels. As may be seen from the accompanying illustration two cables were laid at once, the reels being drawn behind a tractor. This proved to be a much more rapid method of laying cable than that of pulling it off the reel or rolling the reel along on the ground. The equipment illustrated laid the two cables a distance of 6,000 ft. in eight hours.



Laying street-lighting cables by the reel-cart method

READERS' FORUM

Series Capacitors for Line-Voltage Improvement

To the Editor of the ELECTRICAL WORLD:

On page 310 of the February 8 issue there is given an abstract of a series capacitor report presented by a subcommittee of the rural lines committee, Empire State Gas and Electric Association, at the annual meeting last December.

The paragraph in small type at the bottom of the left-hand column is an explanation of the basis of curves shown near the top of the column and labeled "cost of voltage regulation with capacitors." I doubt whether a casual reader would associate this paragraph with the chart and a complete understanding of the chart cannot be had without this association.

It occurs to me that one of the principal points I emphasized in presenting this paper at the meeting, while not a part of the report, is well worth mentioning. The curves show the lowest total operating cost occurs for the 3-mile line. These curves apply only to No. 4 copper, and the point which should not be lost sight of is that 3 miles is the most economical line for a No. 4 copper circuit only if there is sufficient load to cause a 10 per cent full load voltage drop. As read from the chart the load in this particular case would have to be about 360 kw. at power factor 75 per cent.

E. K. KARCHER.

New York Power & Light Corporation,
Albany, N. Y.

BOOK REVIEWS

Electromagnetic Problems in Electrical Engineering

By B. Hague. London: Oxford University Press. 359 pages, illustrated. Price, $10.50.

This is a text dealing with the application of electromagnetic principles to the magnetic field and with the magnetic forces in electrical machinery and apparatus. The book is divided in two parts, the first of which is a fundamental development of principles and theoretical discussion of magnetic fields and the second is the application of the principles to machinery and apparatus.

The author is a master of his subject and rigidly holds to principles with citations of authority where he does not develop the technical equations. His generalized approach to the subject is admirable and enables him to treat of machines as a class with a common electromagnetic problem. Several splendid electromagnetic problems are included and a very thorough treatment is given the magnetic field of linear conductors and those developed by usual machine combinations. An interesting discussion of vector potential and the expert use of this tool to get solutions of certain technical problems is a feature of the book.

* * * *

Das Rechnen mit Vektoren in der Elektrotechnik

By R. Lundholm. Stockholm: Centraltryckeriet. 98 pages, 27 diagrams.

This is a mathematical text on the applications of vector analysis in electrical theory. In the preface the author states that difficult problems, such as the study of transients during short circuits, or oscillations in machine operations, have commonly been attacked by certain customary mathematical methods. He undertakes to show that such problems can be effectively approached by applying a generalized form of vector analysis. A number of cases are worked out, for example, stability in the parallel operation of synchronous machines.

* * * *

The Electrical Industry of Great Britain

Prepared by the Economical and Statistical Department of the British Electrical and Allied Manufacturing Association, 36 Kingsway, London, W. C. 2. 233 pages.

A very interesting and valuable analysis of the British electrical industry has been issued recently under the title "The Electrical Industry of Great Britain." The organization, productive capacity and world position of the industry are discussed in an exhaustive manner. So also are the financial aspects of the situation.

A rather unusual attitude is taken concerning the market for electrical equipment in the British Dominions. One reads between the lines the impression that these Dominions should buy from British manufacturers. The author seems temporarily to overlook the fact that in the hard battle of business, buyers secure their products where the best opportunities present themselves, taking for granted, of course, the advantage accruing to that seller who systematically and energetically develops his market.

The volume is provided with informative statistical tables showing economic development of the industry and its markets.

* * * *

Electric Street Lighting

By Charles J. Stahl. New York: John Wiley & Sons. 223 pages. Price, $3.50.

The volume supplies the subject matter which will be of common interest to the street-lighting engineer and the various boards and organizations struggling with the civic problems of architectural beauty and general efficacy of street-lighting systems. Apparently for this reason considerable space is given to the elements of illumination in its physical and physiological aspects. Chapters on the electrical apparatus and circuits, lamp performance and some cost illustrations comprise the major portion of the remainder.

Men of the Industry

Colonel Harvey Resigns from Executive Position

COL. C. H. HARVEY, president of the Knoxville Power & Light Company, Knoxville, Tenn., has resigned, having served for more than 25 years as chief executive of that company. His resignation was accepted by the board of directors, who then elevated him to the chairmanship of the board. Mr. Harvey's association with the Knoxville Power & Light Company and predecessor companies dates back about 40

years. A graduate of the University of Michigan, he went directly to the utility field as secretary to the general manager of the East Tennessee, Virginia & Georgia Railroad, which is now the Southern Railway. While employed there he worked at night on the books of the Knoxville Electric Light & Power Company and in 1902 was named general manager of both the Knoxville Traction Company and the Knoxville Electric Light & Power Company. Two years later he was elected president and general manager. Colonel Harvey organized the two utilities into the Knoxville Railway & Light Company, which later became the present Knoxville Power & Light Company. Five years ago he gave up his duties as general manager and since that time has been engaged only in the administrative activities. The board took no action toward filling the presidency, the duties of which will be performed by Fred V. Underwood, vice-president and general manager.

JOHN F. LYNCH has been elected treasurer of the Niagara Falls Power Company to succeed W. Paxton Little, resigned.

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WILLIAM STOKES, formerly secretary and manager of the Indiana Electric Light Association and the Indiana Public Utilities Association, is now engaging in special publicity and contact work for some of the companies in the various branches of the utility industry.

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ROBERT M. FEUSTEL, president of the Indiana Service Corporation, Fort Wayne, has been elected president of the Central Indiana Power Company. For several months Mr. Feustel has been chief operating executive of the Insull Indiana properties.

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F. T. BOLSTER has been appointed executive engineer of the Rome Wire Company division of the General Cable Corporation. Mr. Bolster has been connected with several of the largest utility construction and operating companies during the last twenty years. He will devote his time principally to central station distribution problems.

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F. J. GANNON, since January, 1929, manager of the El Paso Electric Company, Rio Grande Valley Traction Company and the Mesilla Valley Electric Company, has been made president of these companies and a member of their boards of directors. Mr. Gannon, whose headquarters are in El Paso, Tex., has been president of the El Paso and Juarez Traction Company and a member of its board since his advent in El Paso, and in his new position he will continue actively to manage all four companies.

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H. BOYD BRYDON, chief mechanical engineer for the Byllesby Engineering & Management Corporation and for 21 years a member of the Byllesby organization, has resigned, effective March 17. Mr. Brydon was born in London, England, and educated at Finsbury Technical School. In 1900 he removed to Chicago, joining the firm of Sargent & Lundy as assistant engineer. In 1909 he joined the engineering department of H. M. Byllesby & Company. During his affiliation with the Byllesby organization he has worked on many electric power plants.

Gulick Heads Commonwealth Edison Finance Committee

J. H. GULICK, who was made chairman of the finance committee of the Commonwealth Edison Company, as announced in the February 22 issue of the ELECTRICAL WORLD, entered the employ of a predecessor of the Commonwealth Edison Company in 1898 and was engaged in accounting work. About 1899 he left Chicago to join the General Incandescent Arc Light Company of New York, returning to the Middle

West in 1905 as acting auditor of the Chicago Edison Company and Commonwealth Edison Company. He was later appointed auditor of these companies and early in 1914 was elected a vice-president of the present company. Mr. Gulick has also been made a member of the board of directors of the Commonwealth Edison Company.

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J. B. LEDLIE, formerly superintendent of the Mesilla Valley Electric Company, Las Cruces, N. M., a subsidiary of the El Paso Electric Company, has been made vice-president of the Mesilla Valley company.

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H. C. WILDER, formerly assistant to vice-president of the Rome Wire Company division of the General Cable Corporation, has recently been elected vice-president in charge of sales of the Southern States Cable Company division

of General Cable. Mr. Wilder has had wide experience in the utility field and is well known throughout the industry. He will direct the sales of all the corporation's products in the southern territory, which includes Texas, Louisiana, Mississippi, Alabama, Georgia, Florida, North and South Carolina.

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E. E. Potter General Sales Manager Edison Lamp Works

E. E. POTTER, who succeeds G. C. Osborn as general sales manager of the Edison Lamp Works, General Electric Company, was born in Butler, N. J., in 1889. He started his career with the Edison Lamp Works in 1910. Two years later he was made lamp manager of the Syracuse office of the

company, and in 1913 he became lamp specialist for the New York district.

In 1918 Mr. Potter was appointed assistant district manager for the New York district and one year later became manager of the district, which position he held until 1924, when he was appointed assistant general sales manager with headquarters at Harrison. In this post his chief work was to help formulate policies relating to operations with central stations, distributors and retail agents. In addition he directed the work of all sales offices of the company.

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H. STYLES BRIDGES has been named a member o the Public Service Commission of New Hampshire to succeed John W. Storrs, whose term expired some months ago. Mr. Storrs served as a holdover until the Executive Council of New Hampshire confirmed Governor Charles W. Tobey's nomination of Mr. Bridges. Mr. Bridges was for some time connected with the New Hampshire Farm Bureau and has been employed for some years by former Governor Robert P. Bass in the capacity of an executive secretary.

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WALTER J. WALSH, formerly industrial engineer with the Great Western Power Company of California, with headquarters in San Francisco, has recently announced the opening of an office for the general practice of law in that city.

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FREDERICK ALAN SCHAFF has been elected president of the Superheater Company and GEORGE L. BOURNE, retiring president, has been elected chairman of the board of directors. Mr. Schaff became associated with the Superheater Company, in the service department, in 1913 and was elected vice-president in 1915, in which capacity he has served until his recent election to the office of president.

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T. A. KENNEY and E. A. YATES have been elected members of the board of directors and vice-presidents of the Commonwealth & Southern Corporation. Both Mr. Kenney and Mr. Yates previously were vice-presidents and directors, respectively, of the former Commonwealth Power Corporation and the Southeastern Power & Light Company. These properties are being merged into the Commonwealth & Southern Corporation.

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G. C. OSBORN and W. T. L. COGGER have resigned from the General Electric Company to become associated with the R.C.A. Radiotron Company as vice-president in charge of sales and vice-president in charge of manufacturing, respectively. J. E. Kewley has been appointed acting manager of the incandescent lamp department of the General Electric Company and M. L. Sloan has been appointed assistant manager of that department.

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RALPH N. HILL, for the past fifteen years connected with E. E. Clarkson & Company, Burlington, Vt., has been appointed vice-president and general manager of the Green Mountain Power Corporation, Burlington. He is a native of Iowa, a graduate of Iowa Wesleyan University and an experienced electrical engineer. He spent the years following graduation with the Western Electric Company in Chicago and New York. Since 1914 Mr. Hill has been active in business affairs in northern Vermont.

ROY PAGE, new general manager of the Nebraska Power Company. He is filling the position left vacant when James E. Davidson became president. A biographical sketch of Mr. Page was published in the February 22 issue of the ELECTRICAL WORLD.

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R. BOURKE CORCORAN, for the past five years manager of the Electric Association of Chicago, leaves that connection on March 1 to join the J. Walter Thompson Company of New York. Under Mr. Corcoran's direction the Electric Association, started in 1925 by a small group, has accomplished definite objects to the benefit of the industry in both local and larger fields. Among these have been successful promotion of the "red seal" plan in Chicago, the passage of needed legislation affecting electrical contracting in the state of Illinois and the development of the Franklin specification for industrial lighting into national acceptance.

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OBITUARY

GEORGE A. MONTGOMERY, one of a group of men Henry L. Doherty gathered about him when he began his career as a utility magnate, died recently at Joplin, Mo., where he had his headquarters as general manager of the Ozark Power & Water Company, removing there in 1917 from Lincoln, Neb., where he was in charge of the Doherty plants. He was 52 years old. A Canadian by birth, Mr. Montgomery received his training as an electrical engineer at McGill University, Montreal, and had managerial positions later at Quebec and Montgomery, Ala.

Financial and Statistical News

RENEWED CONFIDENCE in bond financing was evident in the new public utility financing during February, when this type of security occupied an outstanding position. New offerings totaled $65,530,000 and not a single stock issue was offered.

——DURING THE WEEK JUST CLOSED stocks on the New York Stock Exchange declined, following the break in agricultural prices, but recovered their losses mid-week. Public utility preferred and common issues showed no significant changes.

——THOUGH BOND TRADING WAS DULL, public utility issues were steady and firm.

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January Showing Favorable

REVENUE 7 per cent higher and energy sales 9 per cent higher than a year ago are revealed by reports thus far received from electric light and power companies for January, comprising about one-third of the industry. These returns indicate a rate of progress during January equal to that of November and December, when revenue gains somewhat slightly in excess of 7 per cent were recorded.

The energy generated by the reporting companies increased but a fraction of 1 per cent, notwithstanding the considerable increase in sales, but that is explained by the fact that reports were not included from a number of large companies that sell most of their energy at wholesale.

Representative returns from New England and the Middle Atlantic states point to an increase in those sections virtually up to normal, particularly in the larger cities. The showing in the upper Mississippi Valley was not so good, but even here the increase promises to be about 4 or 5 per cent; in the eastern and middle South some returns show an actual recession, unusual in the light and power industry, but in the Southwest reports show the usual increase in revenue and in energy sales.

Eastern Utilities Announce Construction Budgets

APPROXIMATELY $27,000,000 has been authorized for the 1930 budget for Public Service Electric & Gas Company, Newark, N. J. This provides for new construction, extensions, improvements and betterments for both the electric and gas departments throughout the company's territory in New Jersey.

The major part of the funds for the electric department will be spent for extensions and reinforcements to the distribution system. More than $5,000,000 will be used for the construction of five new substations, as well as the reconstruction of existing equipment in a number of present substations. Extensions will be made at Bound Brook and Cranford substations. Land will also be purchased for two new switching stations.

The sum of $2,700,000 has been provided for reinforcing electric distributing lines and for the construction of underground conduits in all parts of the system.

In addition to these projects, about $1,500,000 will be spent in the generation department for replacements and improvements in power houses, and nearly a million more comprising the following items: A new distribution

NEW SECURITY ISSUES OF ELECTRIC SERVICE COMPANIES IN FEBRUARY

Name of Company	Amount of Issue Par Value	Period Years	Class	Purpose	Interest Rate	Price	Per Cent Yield
Electric Power & Light Corp.	$15,000,000	100	Gold debentures	To retire current indebtedness, for working capital and for other corporate purposes	5	92½	5.40
Empire Public Service Corp.	3,500,000	20	Gold debentures	To reimburse company's treasury in connection with recent acquisitions, advances to subsidiaries and for other corporate purposes	6	94½	6.50
General Public Utilities Co.	4,000,000	2	Gold notes	To retire maturing obligations and bank loans and for other corporate purposes	6	99	6.60
Green Mountain Power Co.	1,015,000	18	First mortgage gold bonds	To reimburse for the cost of additions and improvements to its properties	5	...	....
Puget Sound Power & Light Co.	3,000,000	10	Gold coupon notes	To refund a similar amount of notes	5½	96½	6.00
Kansas Power Co.	1,000,000	20	First mortgage gold bonds, series A	.....	5	92½	5.70
Memphis Power & Light Co.	2,500,000	18	First and refunding mortgage gold bonds, series A	To reimburse company for expenditures made for additions to property and for other corporate purposes	5	99	5.08
Michigan Public Service Co.	1,615,000	20	First mortgage gold bonds, series A	.....	5	90½	5.90
Missouri Public Service Co.	900,000	20	First mortgage gold bonds, series A	.....	5	90½	5.90
Utah Power & Light Co.	4,000,000	14	First mortgage gold bonds	To reimburse company for expenditures made for additions to property and for other corporate purposes	5	98	5.20
Central States Power & Light Corp.	3,000,000	23	First mortgage and first lien gold bonds	To provide part of the funds for acquisition of properties and for other corporate purposes	5½	90	6.30
Empire Public Service Corp.	3,500,000	20	Gold debentures	.....	6	99½	6.50
Houston Lighting & Power Co.	2,000,000	23	First lien and refunding mortgage gold bonds, series A	To reimburse company for expenditures on extensions and for other corporate purposes	5	97½	5.19
Pacific Northwest Public Service Co.	16,000,000	20	Convertible gold debentures	To retire certain funded debt, to purchase common stock of Seattle Lighting Company and for other corporate purposes	6	99½	6.04
Western Public Service Co.	4,500,000	30	First mortgage, refunding gold bonds, series A	.....	5½*	94½	*5.89
Total	$65,530,000			Rights	$8,627,840		
Total amount actually realized	62,778,575			Total financing for February	71,406,415		

office building in the Essex division, conversion of the old Paterson station building into additional storeroom and garage facilities, new district headquarters at Passaic and new equipment for the testing laboratory of the company at Irvington.

The construction budget of the New York Power & Light Corporation for 1930 for the extension and betterment of the company's gas and electric properties totals $9,600,000 according to an announcement made by Otto Snyder, president of the company. This budget is $1,200,000 higher than the budget for 1929 and provides for expansion in all branches of the company's business. Of the total expenditure planned, $7,200,000 will be for electric improvements, $1,500,000 for gas and the balance for general operations. These are tentative figures prepared in budget form at the beginning of the year. This vast construction activity is under way and large contracts for material and equipment have been placed. No retrenchment in this expansion program is looked for.

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Construction Expenditures Total $198,000,000

INFORMATION from companies representing 85 per cent of the industry indicates that the total expenditures for new construction already made, or to be made by March 31, will be $198,000,000.

This amount is 10½ per cent higher than was expended during the first quarter of the year 1929. Since the total estimated expenditures for new construction during the entire year of 1930 is 8 per cent higher than for 1929, this indicates that a relatively larger proportion of the year's expenditures will be made in this first quarter than in the corresponding quarter of 1929, and that the construction program has been accelerated.

These figures were compiled by the National Electric Light Association.

December Revenue Increased 7 per Cent

DESPITE the slackening in industrial activities, the December revenue of the electric light and power industry in the United States exceeded that of the corresponding month in 1928 by 7.1 per cent, rising to $190,300,000, according to returns received by the ELECTRICAL WORLD. This may be slightly, but not seriously, modified by later returns. This revenue is greater than that for any previous month in the history of the industry, but the daily average, $6,150,000, is slightly lower than that for November. Exactly the same thing happened in 1928, as is evident from the chart. Also, as in 1928, the actual average daily revenue almost precisely coincided with the estimated normal computed on the basis of growth during the preceding five years. The gain over 1928 reached its maximum in August, with a revenue 10.2 per cent greater than in the preceding year; in the remaining four months of the year the relative gain was 9.4, 8.8, 7.1 and 7.1 per cent, respectively. The absence of a further decrease in December is worth noting.

The operating expenses, computed at $76,780,000, rose in virtually the same ratio as did the revenue. It would thus seem to be a fair inference that normal expenditures are not being curtailed.

The gain in energy output, compared with the preceding year, was 8.1 per cent; in November, it was 6.9 per cent. This seems to indicate an acceleration; whether it is the beginning of an upward turn will be revealed by the figures for January. For the only time in 1929 the monthly output fell below the estimated normal computed on the basis of former growth, though only slightly. Water power, which for the first time since last May was up to the output for the corresponding month in 1928, produced 33 per cent of the total energy generated.

Northeast, Southwest and Coast lead in revenue gains

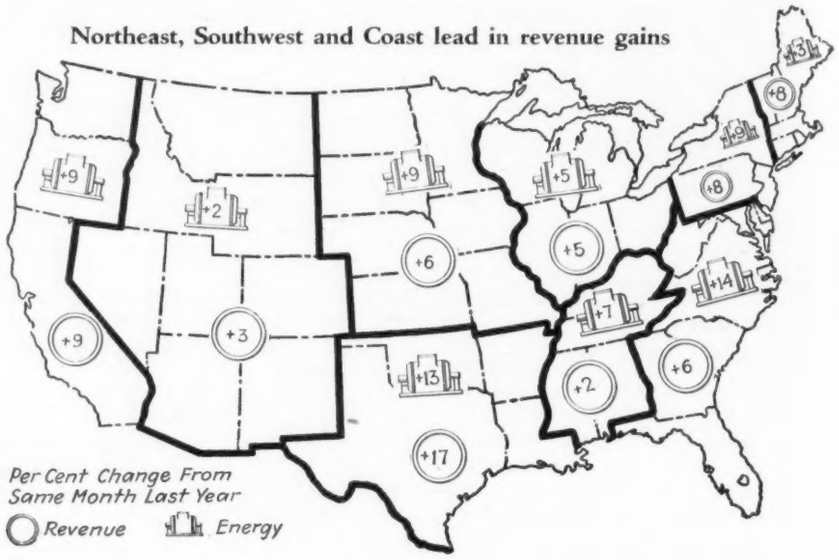


Table I—Central-Station Financial Operations in the United States

Compared with Corresponding Month of Previous Year

Month	Total Gross Revenue from Sale of Energy*			Total Operating and Maintenance Expense†		
	1929 Thousands	1928 Thousands	Per Cent Inc.	1929 Thousands	1928 Thousands	Per Cent Inc.
September..	$170,800	$156,100	+9.4	$72,740	$65,750	+10.6
October....	179,400	164,900	+8.8	76,640	69,800	+ 9.8
November..	187,300	174,800	+7.1	75,450	69,200	+ 9.1
December..	190,300	177,600	+7.1	76,780	71,400	+ 7.6

Table II—Central-Station Fuel Consumption in the United States‡

Compared with Corresponding Month of Previous Year

Month 1929	Coal		Oil		Gas	
	Short Tons	Per Cent Increase	Barrels	Per Cent Increase	Thousands Cubic Feet	Per Cent Increase
September....	3,628,818	+13.6	787,650	+33.7	11,160,817	+53.6
October.....	3,770,782	+ 7.0	1,049,669	+76.2	12,400,837	+58.7
November....	3,504,301	+ 1.9	1,139,627	+91.2	11,482,665	+54.8
December....	3,707,268	+ 4.7	1,069,499	+31.4	10,093,947	+41.8

*Aggregate gross revenue from consumers and from other utilities for energy for resale, involving a certain amount of duplication.
†Do not include interest, taxes, depreciation or sinking fund, with some unavoidable exceptions. ‡As collected by U. S. Geological Survey.

Table III—Energy Output of Central Stations in the United States

Compared with Corresponding Month of Previous Year

Month 1929	Generated, Thousands of Kw.-Hr.*						Purchased for Resale	
	Total		Hydro		Fuel			
	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Thous. Kw.-Hr.	Per Cent Inc.
September	7,681,149	+10.9	2,372,617	—12.5	5,308,532	+26.0	1,745,000	+21.0
October	8,319,024	+10.2	2,644,230	— 5.4	5,674,794	+19.4	1,893,000	+16.4
November	7,889,859	+ 6.9	2,579,477	— 5.1	5,310,382	+14.0	1,798,000	+14.0
December	8,114,234	+ 8.1	2,703,187	+ 0.4	5,411,047	+12.5	1,840,000	+17.5

Table IV—Regional Operations, Revenue and Energy Output in December, 1929

Compared with Corresponding Month of Previous Year

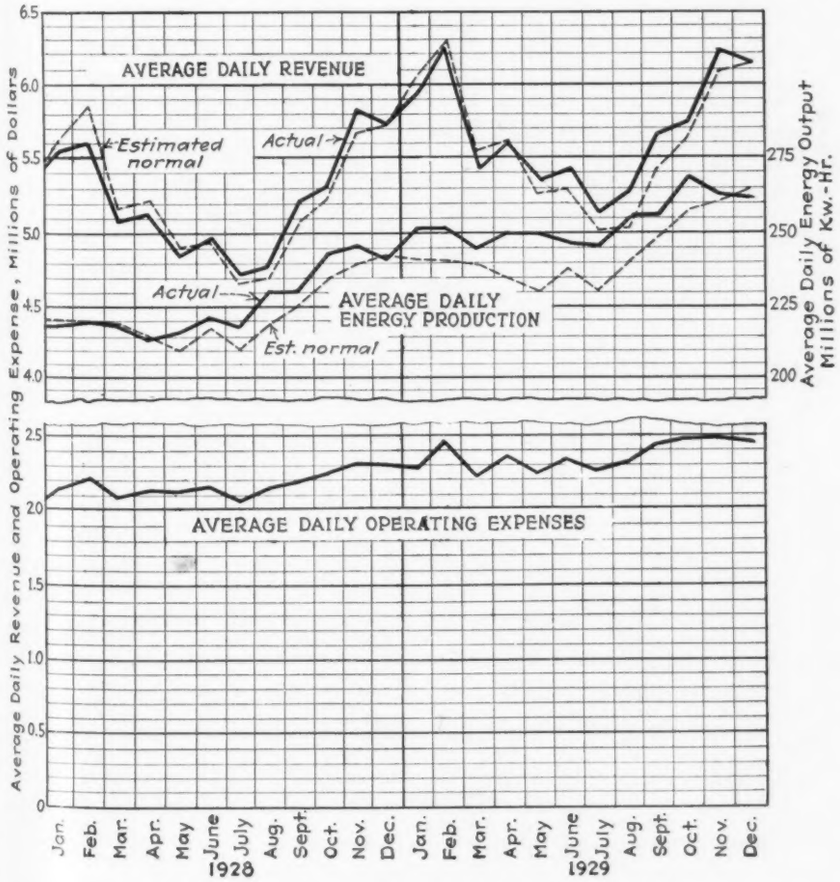
Region	Revenue		Energy Generated, Thousands of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.
United States	190,300	+ 7.1	8,114,234	+ 8.1	2,703,187	+ 0.4	5,411,047	+12.5
New England	19,450	+ 7.5	529,949	+ 3.1	127,905	—22.6	402,044	+15.0
Middle Atlantic	50,170	+ 7.9	2,032,786	+ 9.2	551,125	+ 3.8	1,481,661	+11.3
East North Central	47,650	+ 4.5	2,004,876	+ 5.1	176,099	—19.7	1,828,787	+ 8.3
West North Central	15,770	+ 6.0	479,337	+ 8.8	85,190	—35.2	394,147	+23.5
South Atlantic	19,860	+ 5.7	1,023,486	+14.3	599,386	+36.4	424,100	— 6.9
East South Central	6,480	+ 2.4	301,429	+ 7.4	238,351	+ 5.8	63,078	+13.8
West South Central	9,930	+17.1	420,151	+13.4	5,636	—29.9	414,515	+14.4
Mountain	4,600	+ 2.8	310,752	+ 1.6	251,571	— 3.0	59,181	+28.0
Pacific	16,390	+ 9.3	1,011,458	+ 8.8	667,924	— 6.4	343,534	+59.3

*As collected by U. S. Geological Survey.

The lack of additional energy from water necessitated an increase of 12.5 per cent, compared with December, 1928, of energy generated from fuel, with greater consumption particularly of oil and natural gas, 31.4 per cent of the former and 41.8 per cent of the latter. The increase in coal consumption amounted to only 4.7 per cent.

In revenue increase the North Atlantic seaboard states, as well as those on the Pacific Coast, somewhat exceeded the general average. The greatest relative gain was in the West South Central states, 17.1 per cent. Gains were smaller in the eastern Mississippi Valley and in the Rocky Mountain states.

In a general way the increase in energy output paralleled the increase in revenue, but there are some peculiar exceptions. In the South Atlantic states the energy increased 14.3 per cent, the revenue less than 6 per cent; in New England and in the West South Central States, on the contrary, there was a higher rate of gain in revenue than in energy output. Two factors probably contributed to that condition: A continuance of the transfer, as in other recent months, of energy between regions in response to conditions of load and supply; a decrease in industrial load combined with an increase in domestic and commercial sales. Regional data are given in Table IV, and the percentage changes compared with the same month last year are indicated on the map.



December movement parallel to that in 1928

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NEWS BRIEFS

Stockholders of the Commonwealth Edison Company at their annual meeting held February 24 increased the authorized capital stock from $150,000,000 to $200,000,000.

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The appointment of an executive committee by the board of directors has just been announced by John J. O'Brien, president of Standard Gas & Electric Company. The committee is composed of Mr. O'Brien, chairman; and A. C. Allyn, Victor Emanuel, Halford Erickson, Robert J. Graf and B. W. Lynch.

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New York Stock Exchange has authorized the listing of 1,354,924 shares of preferred stock, $6 series, and 2,022,444 additional shares of common stock of Commonwealth & Southern Corporation on official notice of issuance in exchange for securities of other companies.

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Stockholders of Southern California Edison Company will vote March 21 to approve amendments to the articles of incorporation, providing for a change of name from the present designation to the Southern California Edison Company, Ltd., and for a reclassification of the preferred stock. Directors have authorized the issuance and sale of 283,000 shares of common stock to holders of common and original preferred stock at par, payable in cash.

Business News and Markets

General Electric Assists Disengaged Employees

IN AN EFFORT to place employees available for new positions because of the transfer of the Edison Lamp Works from Harrison, N. J., to Cleveland, Ohio, the General Electric Company inserted the following advertisement in the New York newspapers:

"General Electric Employees Available—The transfer of our headquarters to Cleveland provides an opportunity for local concerns to secure the services of a few efficient General Electric employees trained in accounting, research and statistical work, who, by reason of home ties, cannot be transferred to such a distant point. Every one of them has our unqualified recommendation and would be a distinct asset to organizations in a position to avail themselves of this opportunity."

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Equipment Exports Almost $150,000,000

EXPORTS OF electrical equipment from the United States during the month of December increased approximately 21 per cent over December a year ago to a total of $12,469,583. The total for the twelve months ended December 31 was $149,607,854, against $110,727,500 for the twelve months ended December last year. This is an increase of approximately 35 per cent.

Utilities Place Substantial Sums in New Orders

ACCORDING TO FIGURES issued by the National Electric Light Association, the total amount in new orders for equipment and materials with manufacturers and producers already placed or to be placed by March 31 will be $180,000,000. This is 38½ per cent of the total placements of new orders with manufacturers and producers which it is anticipated will be made during the present year.

This placement of a relatively high proportion of the year's total new orders in the first quarter gives positive indication of progress in carrying out the 1930 construction program of the electric light and power companies.

EXPORTS OF ELECTRICAL EQUIPMENT (PRELIMINARY)

Article	December 1928	December 1929
Generators:		
Direct current—		
Under 500 kw.	127,399	90,136
500 kw. and over	1,160	263,131
Alternating current—		
Under 2,000 kv.-amp.	19,688	19,598
2,000 kv.-amp. and over	8,250	20,101
Steam turbo-generator sets	32,798	54,508
Accessories and parts for generators	66,691	58,133
Self-contained lighting outfits	88,249	79,492
Batteries:		
Flashlight batteries	373,498	340,072
Other dry and wet cell primary batteries—		
Radio B and C batteries (dry)	.....	48,890
Other, not elsewhere specified	.....	137,284
Storage batteries	358,999	274,693
Transforming or converting apparatus:		
Power transformers, 500 kw.-amp. and over	103,917	191,930
Distribution transformers, less than 500 kv.-amp.	71,596	109,735
Instrument transformers	4,386	5,992
Other transformers, not elsewhere specified	103,853	209,883
Complete battery chargers under 15 amp	28,262	9,252
Rectifiers, double current and motor generators, dynamotors, synchronous and other converters	71,048	179,759
Transmission and distribution apparatus:		
Switchboard panels, except telephone	99,628	85,002
Switches, and circuit breakers over 10 amp.	179,785	294,162
Fuses and fuse blocks	30,894	45,392
Watt-hour and other measuring meters	80,787	83,259
Electrical indicating instruments	40,268	52,817
Electrical recording instruments	11,748	18,824
Other electrical testing apparatus	63,853	85,883
Lightning arresters, choke coils, reactors, and other protective devices	50,215	75,357
Motors, starters and controllers:		
Motors, ¾ hp. and under	202,272	204,164
Motors, over ¾ and under 1 hp	45,799	49,637
Stationary motors—		
1 to 200 hp.	221,563	457,310
Over 200 hp.	12,492	49,278
Railway motors	34,041	15,196
Electric locomotives—		
Railway	248,000	166,121
Mining and industrial	44,736	13,405
Station and warehouse electric motor trucks	13,601	15,860
Starting and controlling equipment—		
For industrial motors	117,114	169,862
For electric railway and vehicle motors	6,267	42,625
Portable electric tools	119,463	.....
Portable electric tools, except automotive	.....	98,615
Automotive electric machine tools	.....	2,548
Accessories and parts for motors	194,277	323,026
Electric appliances:		
Electric fans	82,312	116,030
Electric lamps—		
Metal filament	113,562	91,308
Other electric lamps	50,194	37,925
Flashlights	247,351	158,140
Searchlights and projectors	56,500	27,285
Motor-driven household devices—		
Electric household washing machines	153,157	107,605
Electric vacuum cleaners	90,318	105,369
Other motor-driven devices, except tools	74,425	92,598
Electric flatirons	37,671	28,853
Electric cooking ranges	37,543	18,300
Other domestic heating and cooking devices	80,616	75,054
Industrial electric furnaces and ovens	53,752	20,746
Therapeutic apparatus, x-ray machines, galvanic and faradic batteries, etc	206,757	148,661
Signal and communication devices:		
Radio apparatus—		
Transmitting sets and parts	74,593	187,341
Receiving sets	646,108	726,731
Tubes	77,031	281,992
Receiving-set components	356,413	291,316
Other receiving-set accessories	267,585	.....
Loudspeakers	.....	164,124
Other receiving-set accessories, n. e. s.	.....	194,316
Telegraph apparatus	74,462	55,344
Telephone apparatus—		
Telephone instruments	68,201	67,891
Telephone switchboards	19,209	251,789
Other telephone equipment	264,036	572,924
Railway signals, switches and attachments	76,888	44,437
Bells, buzzers, annunciators and alarms	28,337	35,605
Other electric apparatus:		
Spark plugs	158,197	143,300
Other starting, lighting and ignition equipment	46,355	93,035
Insulating material	113,768	133,441
Metal conduit, outlet and switch boxes	80,529	200,316
Sockets, receptacles and lighting switches	173,421	181,081
Electric interior lighting fixtures	211,377	208,256
Electric street lighting fixtures	37,138	63,968
Other wiring supplies and line material	172,471	123,004
Other electrical apparatus not elsewhere specified	916,767	1,188,804
Rubber and friction tape	46,884	56,074
Globes and shades for lighting fixtures	60,649	62,429
Electrical glassware, except for lighting	45,728	14,427
Electrical porcelain:		
For less than 6,600 volts	90,221	47,297
For 6,600 volts and over	62,866	85,924
Electrodes and carbons:		
Electrodes for electric furnaces	149,794	148,242
Other carbon products	46,889	71,897
Insulated iron or steel wire and cable	13,225	26,459
Copper, bare wire	161,059	218,681
Copper, insulated wire and cable	369,982	490,367
Refrigeration sets up to 1 ton capacity	561,770	.....
Refrigeration sets up to ½ ton capacity	.....	503,421
Refrigeration sets over ½ to 1 ton capacity	.....	66,570
Totals	$10,253,497	$12,469,583
Twelve months ended Dec. 31	110,727,500	149,607,854

New Metal for Bronze

DRIVER-HARRIS COMPANY gave a demonstration of a new metal called "PMG" at its Harrison, N. J., works February 28 in the presence of a group of representatives from the larger industries of the country. This test showed the possibility of manufacturing bronze made without tin, with properties superior in practically every respect to tin-bearing materials.

"PMG" metal was developed in England and has been specified by the British Admiralty as a substitute for British Admiralty gunmetal bronze. The Driver-Harris Company has taken over the exclusive rights for this country.

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B uysRefractories

GENERAL REFRACTORIES COMPANY, Philadelphia, Pa., has acquired the refractories properties of Evens & Howard Fire Brick Company of St. Louis, Mo. The Evens & Howard Fire Brick Company refractory plants will be operated by General Refractories Company as the Evens & Howard division, and the sewer pipe operations of the Evens & Howard Fire Brick Company will be continued in operation by the Evens & Howard Company as formerly.

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Copper Market Active

	Feb. 19, 1930 Cents per Pound	Feb. 26, 1930 Cents per Pound
Copper, electrolytic	18	18
Lead, Am. S. & R. price	6.25	6.25
Antimony	8¼	9
Nickel, ingot	35	35
Zinc, spots	5.50	5.50
Tin, straits	39	38¼
Aluminum, 99 per cent	24.30	24.30

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TRADE BRIEFS

Driver-Harris Company, Harrison, New Jersey, has been awarded a gold medal for its exhibition at the Exposition Internacional de Barcelona, Spain, in 1929.

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The Stanley Electric Tool Company, subsidiary of the Stanley Works, New Britain, Conn., announces the purchase of the Ajax Electric Hammer Corporation of New York and will continue manufacture and development in its main plant in New Britain. In the future the name of this line will be changed to Stanley-Ajax.

Directors of Electric Controller & Manufacturing Company, Cleveland, have declared an extra dividend of $3 a share in cash in addition to the regular quarterly disbursement of $1.25 a share, all payable April 1.

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Valentine-Clark Company announces the appointment of M. H. Sperry as vice-president in charge of sales, service and public relations with headquarters at the general offices in St. Paul, Minn.

Perryman to Use Patents of Radio Corporation

AN AGREEMENT has just been concluded between the Perryman Electric Company, Inc., and Radio Corporation of America whereby the former will produce radio tubes under patents and patent applications held by Radio Corporation, General Electric, Westinghouse Electric and other affiliated companies, as well as under its own patents.

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Market Conditions

VOLUME OF central-station buying in the East is on the upward turn, with substation and electric railway apparatus occupying an outstanding position. The various districts report that the business outlook at present is highly satisfactory.

——DEMAND FOR NEW EQUIPMENT on the Pacific Coast is strong. Southeast and Middle West report sustained business.

PACIFIC COAST

—AN UNUSUALLY EVEN RUN *of good orders is reported during the past week and demands seem somewhat stronger in this section of the country. Contracting work is rather slow just now, with abbreviated crews working, but with much prospective work reported.*

Orders included four 1,500-kva., 60,000-volt G.E. transformers, value $35,000 for Woodland; three 3,000-kva., 12,000-volt G.E. transformers, value $25,000, for Santa Clara; $30,000 worth miscellaneous Westinghouse equipment and $20,000 feeder regulators for Portland and a $15,000 switchboard for an Everett lumber company; subway transformers, value $15,000, for Los Angeles. The week's outstanding order covered $50,000 Westinghouse indicating feeder regulators for the city of Seattle. Miscellaneous orders for power companies covered $15,000 worth of high-tension porcelain insulators, two carloads of pole line hardware for San Joaquin valley, one carload fiber conduit and 50,000 lb. No. 4/0 weatherproof wire for Los Angeles, and a carload of crossarms for Oakland. A $20,000 sale of electric ranges to a San Francisco jobber is reported.

Industrial machinery sales include an electric crane for Reno, elevator equipment, value $25,000 for San Francisco; 4,500 thermostats, value $15,000, for Portland; a 600-hp. G.E. motor and controls for an oil company in Richmond and a $4,000 electric furnace for a gear company. Major construction reported covers a $1,000,000 San Jose Hotel, a $2,000,000 San Diego hotel, a $2,000,000 Los Angeles theater, a $700,000 San Francisco church, $650,000 school construction for Modesto, a $750,000 Long Beach hospital, a $1,250,000 plant for a San Francisco newspaper and a $750,000 ice plant for Roseville, an important fruit junction. Much projected lighting work is reported, covering stadiums, tennis courts and practice golf courses. Fresno is figuring on installing an additional 210 single standard and San Bernardino on 153.

General Electric Company secured the award for furnishing approximately $45,000 worth of transformers to the Puget Sound Power & Light Company for use in an outdoor substation in Everett, the contract including three 1,666- and three 2,000-kva. transformers. Fairbanks-Morse Company secured an order for 100 motors, ranging from 100 hp. down, costing about $20,000, and Westinghouse received a contract for six synchronous motors, ranging from 500 hp. down, costing in excess of $18,000, from the Puget Sound Pulp & Timber Company at Everett. Award for the switchboard, costing about $14,000 also was given to Westinghouse and, previously, Fairbanks-Morse secured a contract for 250 motors, from 200 hp. down, from the same company. Other contracts placed include ten motors from 25 hp. down to lumber mills

and 30 machines from 60 hp. down to miscellaneous industrials. A contract for a three-unit pumping plant at Omak, Wash., was let to the Byron Jackson Company for $13,400 and the city of Tacoma opened bids for 13,000 ft. of No. 8 B. & S. single-conductor, 66,000-volt parkway cable, and 67 luminous arc lamps. City of Seattle opened bids for 2,500 No. 4 200 aluminum sockets and city of Caldwell, Idaho, awarded contract for lighting system to Gobby & McNeil of Boise for $8,600. Pacific Mills, Ltd., Vancouver, B. C., plans immediate construction of first unit of paper plant in Vancouver, costing $150,000.

CONSTRUCTION PROJECTS

Great Western Power Company, San Francisco, Calif., plans power substation to cost $500,000. Grand Rapids Store Equipment Corporation, Grand Rapids, Mich., plans plant at Los Angeles, Calif., to cost more than $200,000. Los Angeles, Pomona, Tracy, San Francisco, Orange, Claremont and Fresno, Calif., plan ornamental lighting systems. Proctor & Gamble Company, Cincinnati, Ohio, will take bids for soap manufacturing plant at Long Beach, Calif., to cost $5,000,000. Los Angeles Gas & Electric Corporation, Los Angeles, will build a power substation to cost $100,000. Port Commission, Seattle, Wash., has plans for a terminal building to cost $250,000. Montana-Dakota Power Company, Minneapolis, Minn., contemplates extensions and improvements in power plant at Peerless, Mont. Idaho Falls, Idaho, plans installation of generating equipment and auxiliaries in hydro-electric power plant on Snake River, to cost $100,000. Southern Colorado Power Company, Pueblo, Colo., will make extensions and improvements in power plant at Canyon City, Colo. Public Service Company of Colorado, Denver, will make extensions and improvements in generating plant at Boulder, Colo. Pueblo, Colo., plans ornamental lighting system. Tucson, Ariz., plans ornamental lighting system.

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SOUTHWEST

—MANUFACTURERS REPORT BUSINESS *for the past week as fair. The steady movement of stock motors, distribution transformers and meters continues about the same as usual; the volume of construction materials handled has fallen off slightly.*

Contract was closed last week for a 50,000-watt broadcasting station, equipment to cost $167,000. The only other order of consequence closed was for two 100-hp. synchronous motors for driving ice machines and costing $3,000.

CONSTRUCTION PROJECTS

Columbia, Mo., will soon take bids for equipment for municipal power plant to cost $80,000. J. R. Brockman Manufacturing Company, St. Louis, Mo., has plans for steam equipment manufacturing plant to cost $100,000. St. Louis Electric Terminal Railway Company, St. Louis, is completing plans for terminal building to cost $1,000,000. Concordia, Mo., plans bond issue of $30,000 for municipal electric lighting plant. Texas Electric Company, Big Spring, Tex., plans transmission line to Lamesa, Tex., and vicinity. Texas Power & Light Company, Dallas, Tex., contemplates extensions and improvements in power plant at Trinidad, Tex., reported to cost $200,000. Waelder, Tex., contemplates a municipal electric light and power plant reported to cost $50,000. Board of Education, Dallas, Tex., will receive bids until March 15, for Dallas Technical School, to cost $200,000. Gulf, Colorado & Santa Fe Railroad Company, will build additions to shops at Cleburne, Tex., to cost $300,000.

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MIDDLE WEST

—GENERAL BUSINESS *in the Middle West section shows signs of considerable spottiness. The volume is substantially large, but production in the major activities has not developed at as high a rate as anticipated. While considerable improvement is apparent in the steel and automotive industries, industrial activity is still somewhat slow.*

—THE VARIOUS RAILROADS *are continuing with their investment programs, and this, in conjunction with the expenditures being made by the utility companies, creates an optimistic feeling toward future business.*

—WHILE EMPLOYMENT *has improved somewhat, the situation is still somewhat acute. Road construction work and the starting of several large projects are expected to relieve this situation somewhat. Buying is going on for the most part on a hand-to-mouth basis.*

Some of the interesting orders placed this week include a construction order for the superstructure of a generating plant to cost in excess of $1,000,000, 99,000 ft. of 1,000,000-circ.mil, 132-kv. oil-filled paper and lead-insulated cable and "Mazda" lamps valued at $150,000.

Jobbers' sales continue somewhat slow. There has been a good demand from railroads and the coal mining sections, but spottiness in the industrial field is being reflected in jobbers' sales. Several large governmental inquiries for materials are being quoted upon and some municipal business is being obtained.

CONSTRUCTION PROJECTS

Two Rivers, Wis., contemplates extensions and improvements in municipal power plant with additional equipment to cost $100,000. Detroit Public Lighting Commission, Detroit, Mich., has authorized plans for a power substation to cost $100,000. Bundy Tubing Company, Detroit, Mich., plans expansion program at plant to cost $100,000. American Rolling Mill Company, Middletown, Ohio, contemplates iron and steel mill at Detroit, Mich., with power house to cost $15,000,000. Michigan College of Mining & Technology, Houghton, has approved plans for electrical and mechanical engineering laboratory to cost $230,000. Public Service Company of Northern Illinois, Chicago, will soon begin addition to power plant at Waukegan, Ill., to cost $130,000. Firestone Tire & Rubber Company, Akron, Ohio, plans factory branches and distributing plants at Stockton and Palo Alto, Calif., each to cost $200,000. Libby-Owens Glass Company, Toledo, Ohio, will build addition to sheet glass plant to cost $500,000. Mississippi Valley Barge Line, Cincinnati, Ohio, has plans for freight terminal to cost $650,000. Northern Ohio Power & Light Company, Akron, Ohio, plans three power substations to cost $650,000. Cooperstown, N. D., contemplates a municipal electric light and power system. St. Paul, Minn., has authorized an ornamental lighting system. Marshall, Minn., will make extensions and improvements in municipal light and power plant to cost $50,000. Washington, Iowa, contemplates installation of electric light and power system.

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SOUTHEAST

—A SATISFACTORILY SUSTAINED VOLUME *of business is reported for the Southeast and conditions in general are considered highly favorable.*

A power company in East Tennessee has placed two additional orders for oil circuit breakers, transformers and lighting arresters, one amounting to $130,000 and the other, $100,000. A North Carolina company ordered switchboard and miscellaneous apparatus amounting to $50,000, while a Georgia company ordered 260,000 lb. of bare stranded and bare and weatherproof solid copper wire. Some other orders from Georgia were for a combustion control system, amounting to approximately $8,000, for the Atkinson plant, near Atlanta, and $6,500 in rails for the street railway in Atlanta. One company's distribution and small power transformer orders last week aggregated $4,550 and its creosoted pine pole purchases $4,050.

Some other central station orders were for $4,500 of oil circuit breakers, cable amounting to $3,575, street lighting material totaling $3,050, and two network protectors costing approximately $3,000. Two orders were placed by the steel and iron industry in the Birmingham district for motors and control equipment, each order approximating $25,000. The Georgia Power Company has just completed a three weeks table appliance campaign and sold 2,200 waffle irons, 1,958 percolators and 1,103 toasters.

CONSTRUCTION PROJECTS

West Virginia Foundry & Stove Company, Huntington, W. Va., plans addition to cost about $80,000. Ashland Refining Company, Ashland, Ky., plans power plant and oil storage and distributing plant to cost $100,000. Nebo, N. C., contemplates

a municipal electric light and power system. Gulf States Steel Company, Gadsden, Ala., plans extensions and improvements in mill, including power plant, to cost $15,000,000. Birmingham, Ala., plans installation of floodlighting system and beacon lamps at proposed municipal airport to cost $1,000,000. Tennessee Coal, Iron & Railroad Company, Birmingham, Ala., plans expansion and improvement program at Ensley Works, reported to cost $4,000,000. Columbus Electric & Power Company, Columbus, Ga., contemplates construction of transmission line to Nashville, Ga., and vicinity. Merrill-Stevens Company, Miami, Fla., plans floating drydock for shipyard service to cost $150,000. Florida Power Company, St. Petersburg, Fla., plans transmission line to Williston, Fla., and vicinity with substation facilities. Chattanooga, Tenn., plans installation of floodlighting system and beacon lamps at proposed airport to cost $200,000.

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EASTERN

—CENTRAL-STATION BUYING *is on the upward trend in the New York electrical equipment market, with pronounced demand for substation apparatus for spring delivery. Wire and cable, also, are sharing in the call, and the outlook for further commitments is promising.*

—INDUSTRIAL PURCHASES *are showing a spotty tendency and the tariff controversy at Washington is showing its effect in retarding expansion in plants and equipment. Railway electrical apparatus continues under advancing market momentum.*

Sizable transactions are being recorded for transformers, switching equipment and accessories. A power company in northern New York has purchased a quantity of such apparatus from a state manufacturer, costing $125,000. Another central station in the same district has contracted for transformers and other substation equipment to an amount of $150,000. A Pennsylvania manufacturer has closed for a switchgear and switchboard installation for a municipal power station in Wisconsin. A central station in Louisiana has given a commitment to a New York manufacturer for transformers and auxiliary equipment to cost $90,000. A manufacturer of heavy electrical machinery and other equipment in Pennsylvania shows marked increase in sales for the first two months of 1930, the volume averaging from 35 to 40 per cent in excess of the same time a year ago.

Iron and steel mills, as well as other branches of the metal-working industries, are giving indications of early purchases. Inquiries for mill motors, controls and accessory apparatus are increasing. Textile mills, likewise, are showing a buying tendency and the demand from the south shows upward tendencies. A mill in South Carolina has purchased a 1,500-kw. turbo-generator unit from a Middle West manufacturer for a new power plant installation. A maker of electric automotive equipment says that the first two months of this year show considerable improvement in sales over November and December; automobile manufacturers are coming into the market for 1930 requirements and outlook is encouraging. A manufacturer of control apparatus reports a volume of business to insure capacity operations at plant; current sales, however, are slackening and demand is not as good as at this time a month ago; inquiries are declining. A manufacturer of transformers in New Jersey is finding improved business; current call is stated as fair, with prospects giving encouragement. Trade is better, it is said, by 5 to 10 per cent over this same period of last year.

Electric railway systems and electrification of steam roads hold as a market leader. A state manufacturer has secured an order from the metropolitan subway lines for equipment to an amount of $950,000, supplementing other recent business from this source. The Canadian Pacific Railway has scheduled two gas-electric railway cars in early purchase budget; early commitments are in sight for similar units from a number of other roads. Wire and cable is securing good demand from this same quarter.

CONSTRUCTION PROJECTS

United Zinc Smelting Corporation, New York, will make extensions and improvements in plant at Moundsville, W. Va., to cost $200,000. National Biscuit Company, New York, has filed plans for improvements and extensions in plant to cost $200,000. Buffalo General Electric Company, Buffalo, N. Y., will build a power substation. Radio Corporation of America, New York, will build a high-power transmitter station near New Brunswick, N. J., to cost over $1,000,000. Bakelite Corporation, New York, will build an addition to insulating material plant at Bloomfield, N. J., to cost more than $100,000. American Tobacco Company, New York, has approved plans for a power plant at factory at Richmond, Va., to cost over $75,000. Morris, Wheeler & Company, Philadelphia, Pa., will build a steel fabricating plant to cost over $100,000. Department of Public Safety, Philadelphia, Pa., will receive bids until March 18, for extensions and improvements in power plant at the City Hall. Pennsylvania Power Company, Sharon, Pa., plans outdoor type power substation to cost $140,000. Fort Wayne Corrugated Paper Company, Fort Wayne, Ind., plans plant at Connellsville, Pa., to cost about $200,000. Aluminum Company of America, Inc., Pittsburgh, Pa., will carry out expansion program at mills at Alcoa, Tenn., reported to cost over $250,000. United States Engineer Office, Pittsburgh, Pa., will receive bids until March 5 for three capstan motors and controls (Circular 513). Morgan College, Baltimore, Md., will take bids at once for an industrial science school to cost $125,000. Division of Supplies, Department of Commerce, Washington, D. C., will receive bids until March 11 for erecting, wiring, etc., of two 125-ft. steel radio antenna towers at Cheyenne, Wyo. (Proposal 21999). Bureau of Yards and Docks, Navy Department, Washington, D. C., will receive bids until April 4 for an automatic refrigerating machine for navy yard at Pearl Harbor, T. H.

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NEW ENGLAND

—ELECTRICAL EQUIPMENT SALES *in New England are maintaining an encouraging level; particularly small motors, industrial electric heat-treating furnaces, scheduled materials and electric lighting equipment are active.*

Sales of small motors in this district are steady and maintain a level above that of last year. Recently several interesting lot orders were reported, one amounting to over $12,000 including new switch and control apparatus. Replacement of group drive in southern New England mills has stimulated sales and one prominent manufacturer placed motor orders amounting to $40,000 during the past week. Activity in generator sets is stronger; inquiries for heavy electrical machinery include specifications for large power motor for rolls and new equipment for metal trades. Central station supplies are moving well; outside control orders are increasing and include pole line materials for southern and southwestern line extensions. Transformer sales for this month were ahead of those for last year at this time. Recently additions to substations in eastern Massachusetts reflected a number of orders, which according to one manufacturer amounted to about $36,000.

Industrial electric heating furnaces are attracting interest; negotiations which total over $50,000 are being considered by one manufacturer; special non-ferrous heating furnace sales are encouraging. Negotiations for heavy electrical machinery include equipment for a large Maine paper mill project which will involve about $750,000. Plans for the extension of power generating plants in eastern Massachusetts are announced. Merchandising is ahead and general business conditions are better.

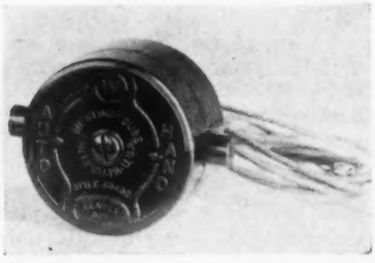
CONSTRUCTION PROJECTS

Eastern Massachusetts Electric Company, Salem, Mass., contemplates steam-operated electric generating plant to cost $15,000,000, with transmission system. City Hospital, Boston, Mass., has filed plans for a power plant at Mattapan Hospital to cost $250,000. Boston Municipal Airport, Boston, Mass., contemplates installation of additional lighting equipment at airport. Charles H. Tenney Company, Boston, plans power station, Salem, Mass., to cost $15,000,000. Norwood Airport, Norwood, Mass., will cost about $1,000,000.

New Equipment Available

Three-Position Switch for Magnetic Starter

A THREE-POSITION, single-pole, double-throw, control switch intended for use with a magnetic starter controlled by an automatic master switch, such as a thermostat, pressure or float switch, has been announced by the Westinghouse Electric & Manufacturing Company. The center position is the "off" position.



The motor runs when the switch is in the "hand" position and when it is in the "automatic" position. The motor is started and stopped by the automatic master switch.

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Matched Frame Ball Bearing Motor

A NEW TYPE of matched frame ball bearing motor has been announced by the Baldor Electric Company, St. Louis, Mo. The various types, including three single-phase windings, split-phase, repulsion induction and condenser type, as well as corresponding ratings in direct current and polyphase, have identical frame construction in appearance and dimensions.

Thrust and lubrication problems are eliminated, it is claimed, by the use of high-grade ball bearings in a special mounting that has proved successful for fan duty. For the condenser motor special controls have been developed to meet the need for variable speed fan service.

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A NEW STORAGE TYPE electric water heater is announced by the Westinghouse Electric & Manufacturing Company. It is designed for either full or semi-off-peak heating and for providing either continuous or intermittent service. With both elements of the dual-element heater in multiple, maximum wattage is delivered. If one unit is connected with the line, half-wattage is obtained. Quarter-wattage results from series connection. When one heater is connected through a timing device to a semi-off-peak meter, advantage may be taken of the lower power rate often available for this type of load. The Spencer thermostat and the Corox heating element give this heater automatic control along with convenient and exceptional operating efficiency.

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Magnetic Controller Allows Motor Isolation

THE REDESIGN of its line of magnetic controllers for steel mill auxiliaries has been announced by the General Electric Company. A separate line contactor is used instead of a "circuit breaker" contactor. This allows complete isolation of the motor and starting resistor from the source of power. An additional relay is used for under-voltage protection.

The overload relay is accurate in adjustment and is not affected by vibration, it is claimed. A large number of the parts of the overload relay are interchangeable with those of the accelerating relays.

New master switches have been developed for use with the panels, to allow single- or three-point operation of the line contactor. The handle of the switch is fitted with a well-designed grip and may be locked in the "off" position.

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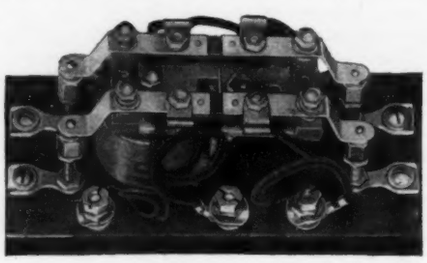
Double-Pole Relay Has Four Circuits

A DOUBLE-POLE, double-throw relay, type DDBL8, with four separate circuits has been announced by Struthers



Dunn, Inc., Philadelphia. This relay can be supplied with glass cover and is applicable to a large variety of uses, it is claimed. It is used for an emergency transfer relay and for transferring an a.c. load fed from an a.c. supply to d.c. load and d.c. supply on failure of the voltage supply to the coil.

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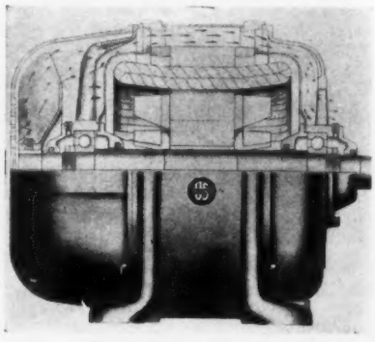
Sealed Metal Housing Incased Motor

AN IMPROVED MOTOR which is incased within a sealed metal housing, outside of which is a chamber that is air-blasted by positive fan action, has been



announced by the U. S. Electrical Manufacturing Company, Los Angeles. Any dust, dirt, moisture or deteriorating element is immediately expelled from the outer chamber, making it impossible for the foreign matter to enter the chamber where the moving parts are housed.

This motor is said to have all the advantages of one fully inclosed and also embodies asbestos protection wherein the wires are insulated by the incombustible fibers of asbestos in conjunction with a heat-resisting compound known as "Asbestosite." Its service is more general in industries where dangerous fumes, moisture, dripping water, atmosphere heavily laden with abrasive particles and dripping acids and alkalies are prevalent.

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AN EMERGENCY STOP SWITCH, designated Sy-109-B, is announced by the General Electric Company. It is for use where an emergency device, externally located for shutting down the compressor motor in any emergency which might result in the leakage of ammonia fumes, is required. The switch has a glass cover and is provided with a small hammer on a chain. The cover holds one set of switch contacts in a closed position. The equipment which this switch would control would be started and stopped by means of a magnetic switch.